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David J. Lehmiller • Editor

Alan W. Meerow • Associate Editor

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HERBERTIA 62 • 2008

EDITOR'S COMMENTS

We have managed to shower the Membership with a flurry of publications during the last 9 months, and we are nearing our goal of returning the Society's publications to current status. Bringing us back to a regular publishing schedule has been the foremost goal of the IBS President, Herbert Kelly Jr., and he has been forever in the background, providing us with encouragement and support. And with this in mind, I wish to put forth a deadline for submission of manuscripts, accounts, and reports for *Herbertia* Volume 63, 2009 – November 15, 2008.

Our Herbert Medalist for 2008 is Dr. Mark Bridgen, who submitted his first paper to *Herbertia* following its presentation at the International Symposium on Bulbous and Cormous Plants hosted by the Society at Irvine, California in February 1989. The topic of his presentation, of course, was on breeding *Alstroemeria*, one of his major horticultural interests. He also served a brief stint as President of IBS.

The Traub Awardee for 2008, William "Bill" Drysdale, unfortunately passed away during the interval between when he was selected for this award and its publication. Bill was undoubtedly the tenured member of IBS at the time of his death, having joined the Society in 1941.

Then follows a series of articles which proclaim that we are truly an international organization. There are articles originating from or pertaining to plants in Spain, Israel, South Africa, United States, Madagascar, Mexico, Chile, and Australia. In addition, there is a featured review (Part I) on the Genus *Ledebouria* in South Africa.

The Board of Directors hopes that the expanded color photography displayed in *Herbertia* meets with enthusiastic approval from the Membership.

—David J. Lehmiller, Editor

TABLE OF CONTENTS

HERBERTIA**VOLUME 62, 2008**

Editor's Comments	6
The Herbert Medal and Recipients	9
Dr. Mark P. Bridgen, 2008 Herbert Medalist	12
The Traub Award for Distinguished Service	36
William T. Drysdale, 2008 Traub Awardee	37
In memoriam: the William T. Drysdale I knew Herbert Kelly Jr.	43
<i>Narcissus x moronensis</i> Knoche (Amaryllidaceae), a new autumn flowering <i>Narcissus</i> hybrid from southern Spain Gerd Knoche	45
Amaryllids of Israel - overview, conservation and cultivation Ori Fragman-Sapir	59
<i>Prototulbaghia</i> (Alliaceae), a new monotypic genus from Sekhukhuneland, South Africa Stefan Siebert, Canio Vosa, Abraham E. van Wyk, and Hardus Muller	76
Synopsis of the genus <i>Ledebouria</i> Roth (Hyacinthaceae) in South Africa – Part I S. Venter	85
The Atamasco and Simpson rainlilies Victor W. Lambou	156

HERBERTIA 61 • 2007

<i>Crinum hanitrae</i> , sp. nov. (Amaryllidaceae), from extreme North Madagascar David J. Lehmiller and Alvin L. Sisk	180
Winter 2008 expedition to Southern Mexico Guy Wrinkle	188
<i>Tecophilaea cyanocrocus</i> : demolishing bad science John M. Watson	209
Presumptive natural hybrids between <i>Crinum uniflorum</i> and <i>Crinum angustifolium</i> (Amaryllidaceae) in Australia David J. Lehmiller	241
Book Review Robert Pries.....	247
Common Conservation Policy	250
Contributor's Guidelines for HERBERTIA.....	252
IBS Pins	256

THE HERBERT MEDAL



The Herbert Medal is the highest honor that the International Bulb Society can bestow upon a person for meritorious achievement in advancing the knowledge of bulbous plants. The medal is named for William Herbert (1778-1847), son of Henry Herbert, Earl of Carnarvon. William Herbert had a predilection for amaryllids and achieved success in their hybridization. He published his research findings in several monumental works. His contributions as a pioneer geneticist and plant breeder, and his arrangement of the Amaryllidaceae, helped set the stage upon which other workers, both amateur and professional, have been able to advance.

The Herbert Medal may be awarded annually or on special occasions by the Board of Directors of the Society. Candidates for the Medal are recommended to the Board of Directors by the Awards and Recognition Committee. Medalists need not be members of the Society to be considered for the Herbert Medal. The award includes honorary life membership in the Society.

HERBERTIA 62 • 2008

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HERBERTIA 62 • 2008

2008 HERBERT MEDALIST

DR. MARK P. BRIDGEN



DR. MARK P. BRIDGEN, 2008 HERBERT MEDALIST

DR. MARK P. BRIDGEN**AUTOBIOGRAPHY**

Mark Bridgen was born on March 17, 1955 in the city of New Kensington, Pennsylvania to Raymond and M. Pauline (Calcagni) Bridgen. At that time, western Pennsylvania was a place where coal mines and steel mills were the major employers. Mark lived in a populated, suburban section of the city that was ethnic Italian. Because his grandparents on his mother's side were immigrants from Italy, Mark's family followed many of the customs, traditions, and values of the Italians. Family, education, hard-work, religion, and loyalty were important aspects of life.

Even as a young boy, Mark realized that he was not a "city boy" and enjoyed going to the countryside. His grandparents, Marco and Irene Calcagni had a modest home in rural Pennsylvania close to Mark's home. Mark and his older brother Michael would spend time at their grandparent's enjoying the countryside, hiking, and enjoying the wonderful Italian food prepared by their grandmother. It was common for the entire family to meet on Sundays after church at their grandparent's house to have dinner together and spend the afternoon visiting.

Mark was very involved with Boy Scouts of America beginning at the age of 11. When he was 14 years old, he began to spend his summers in Washington County, Pennsylvania working as a counselor at the BSA Camp Anawanna and worked there every summer for 4 years. It was here that Mark developed his love of plants and appreciated their potential. Mark's involvement with Boy Scouts was one of the most influential parts of his life. Thanks to the encouragement of his father, he reached the highest rank of Eagle and became a Vigil Honor member.

In January of Mark's senior year in high school, his birth date was pulled for the military draft. Upon graduation from high school, he would have to join the military service and most likely be sent to Vietnam. Fortunately, the elimination of the draft system shortly before his graduation allowed Mark to attend Pennsylvania State University (PSU) instead. There he studied horticulture. During his time at PSU, Mark had the opportunity to benefit from the teachings of many authorities in floriculture including Dr. John White, Dr. John Mastalerz, and Dr. Chiko Haramaki. He was also very fortunate to meet a future mentor for plant breeding, Dr. Richard Craig. Dr. Craig had an exciting and active program

HERBERTIA 62 • 2008

in breeding *Pelargonium* (geraniums); his enthusiasm for plant breeding was contagious and Mark “caught the bug”. Mark and Dick remain friends and colleagues to this day.

Mark remembers his introductory plant breeding class as the turning point of his professional and personal life. It was during his first laboratory class that he was required to pollinate some geranium plants; there in the greenhouses, he met his future wife, Margot Manfredo. Mark acknowledges that while it sounds clichéd, for him it was love at first sight. He knew at that moment when they first met that he wanted to be with Margot for the rest of his life. As a fellow horticulturist, Margot had similar interests and values. They married after graduation on October 8, 1977 at the age of 22.

Following graduation from PSU, Mark and Margot moved to Columbus, Ohio and both received their M.S. degrees from Ohio State University. Mark’s major mentor during these years was Dr. Rod Sharp, a world authority in plant tissue culture. As a result of Mark’s thesis on “Low Pressure and Controlled Atmosphere Storage of Plant Tissue Cultures”, he was invited to speak to the International Plant Genetic Conservation-Recalcitrant Seed and Tissue Culture Meeting in Reading, England in 1980; this was his first international trip.

After receiving their master’s degrees, Mark and Margot moved to Blacksburg, Virginia where Mark worked on a PhD degree at the Virginia Polytechnic Institute and State University (VPI) under the supervision of a well-known potato geneticist, Dr. Richard Veilleux. During that time at VPI, Mark appreciated the opportunity to also work with Dr. Robert Lyons and learn from Dr. Thomas Fretz, who was responsible for recruiting Mark to VPI. In 1983, Mark received the Philip R. White Award from the Tissue Culture Association.

In 1984, Mark graduated from VPI and began his first university position as an Assistant Professor at the University of Connecticut in Storrs, CT. On November 29 of that year, Mark’s son, Devin T. Bridgen was born; Mark describes this date, along with April 11, 1988, the day when their daughter Emily was born, as the happiest days of his life. While at the University of Connecticut, Mark had the opportunity to know and befriend the excellent plant breeder Dr. Gustav Mehlquist (1906-1999) who was well known for his orchid and rhododendron breeding. Also on the faculty was Dr. Sidney Waxman (1923-2005), who worked on the development of dwarf conifer plants from witches’ brooms. Mark and Margot became personal friends with Dr. Waxman and his wife Florence.

While at the University of Connecticut, Mark taught classes in plant propagation, herbaceous plant materials, plant micropropagation, and a graduate class in plant tissue culture. His greatest joy came from interactions with the students; he especially enjoyed advising the Horticulture Club which held an annual, well-known Horticulture Show. This show was the recipient of the University's the 'Program of the Year Award' in 1996. Mark's teaching was recognized by the University in 1998 when he was the recipient of the 'Excellence in Teaching Award' from the College of Agriculture and Natural Resources Alumni Association. He was also the first recipient of the University of Connecticut's Faculty Advisor Award in 1995.

Mark Bridgen's breeding program with Chilean geophytes began in 1985 as a result of being awarded a research grant from the American Floral Endowment (AFE) to breed *Alstroemeria*, also known as the Lily-of-the-Incas or Inca Lily. Later Mark's program also received support from the Gloeckner Foundation to continue his work with the Inca Lily. Hybrid cut flower varieties of *Alstroemeria* were relatively new to the United States at that time, and the Dutch held plant protection rights on all cut flower cultivars. The AFE wanted new, American cultivars to be developed. Mark began his breeding program in a traditional manner by identifying species in herbarium reports followed by collecting plants from their country of origin. Most of the *Alstroemeria* species originate in Chile and Brazil.

Mark made his first exploratory plant collecting trip to Chile in 1986 when the country was still under the control of Augusto Pinochet. Mark's first plant collecting trip to Brazil was in 1987 with his new friend in *Alstroemeria* breeding, Fred Meyer (Escondido, CA; deceased in 1999). Mark's most memorable and educational plant collecting trip was to Chile in 1988 with a small group of five plant enthusiasts including the exceptional Chilean botanist, Adriana Hoffman, and Dr. Harold Koopowitz from the University of California in Irvine. That year it had rained in the Atacama Desert which resulted in an extraordinarily abundant bloom of native geophytes. Thanks to the experts who were traveling with him, Mark became familiar with several new species to him including *Leucocoryne*, *Conanthera*, *Zephyra*, *Pasithea*, and *Rhodophiala*, which later in his career, became plants of interest for breeding.

In the 1980's Mark and his graduate students (listed later in this article) began to cross species of *Alstroemeria* from Brazil, such as *A. caryophyllaea*, *A. braziliensis*, and *A. pulchella* (*A. pstittacina*), with species from Chile such as *A. aurea* (*A. aurantiaca*), *A. pelegrina*, *A. pelegrina alba*, *A. magnifica*, *A.*

magnifica magenta, *A. diluta*, *A. hookeri*, *A. ligtu*, *A. revoluta*, *A. versicolor*, and *A. werdermannii*. It was difficult to successfully produce both interspecific and intraspecific crosses. Scientific investigations later showed that most of the pollinations succeeded; however, the mother plant identified these crosses as “lethal genes” and spontaneous embryo abortion occurred within 14-21 days, depending on the cross. When this was understood, the *in vitro* procedure of embryo culture (also known as embryo rescue) was used to allow hybrids to survive. Approximately 10 to 15 days after pollination, ovules would be aseptically removed from the ovaries. Embryos were not removed from the ovules; instead it was much easier to culture them *in ovulo*. On average, 60% or more of the crosses were able to survive by using embryo culture compared to no survival if the ovary remained on the mother plant.

In the 1990's, the University of Connecticut began a Plant Biotechnology Center and Mark was asked to head this facility. With this additional resource, other *in vitro* techniques were incorporated into the development of new *Alstroemeria* cultivars. Techniques such as somaclonal variation (*in vitro* mutation), somatic embryogenesis, meristem culture, and micropropagation were used along with embryo culture. These procedures allowed new, disease-free plants to be developed as well as a means to easily propagate the hybrids that were produced. Because *Alstroemeria* plants are monocotyledons that grow from underground rhizomes, they are slow and difficult plants to propagate through traditional division. However, *in vitro* micropropagation allows many more propagules to be produced.

In 1991, Mark was promoted to Associate Professor and took his first sabbatical leave at the Danish Research Centre for Horticulture in Aarslev, Denmark as a guest of the Danish Pot Plant Growers. There, he worked on the production of *Alstroemeria* as a potted plant. His stay in Denmark reinforced Mark's notion that the breeding of *Alstroemeria* for cut flowers should not be his primary breeding objective; the United States was not a major cut flower producer due to the strength of the cut flower import market. Rather than having a breeding objective of long stem, greenhouse-grown cut flower *Alstroemeria*, he shifted his focus to the breeding for winter-hardiness and compact growth habit. Such plants could be grown and enjoyed in the garden or in pots. Mark remembers clearly how the Dutch breeders tried to discourage him from this activity, but then years later began themselves to breed for compact, potted plants. Learning from this important lesson, Mark encouraged his students who were interested in

breeding to pursue their dreams and ambitions, even if others discouraged them.

Later in the 1990's the first hybrid *Alstroemeria* plants began to be introduced from Mark's program. Because Connecticut is called the Constitution State, the first group of *Alstroemeria* plants to be introduced was called the "Constitution Series". Mark's first patented introductions were called 'Redcoat' (red flowers; Fig. 1), 'Patriot' (purple flowers; Fig. 2), 'Liberty' (pink and white stripes; Fig. 3), and 'Freedom' (pink; Fig. 4). Another cultivar that was introduced later in October 2000, was 'Patricia Lynn' (Fig. 5); this small-flowered cultivar is winter hardy to USDA zone 6. These cultivars still exist, but only 'Freedom' and 'Patricia Lynn' are sold commercially.

Probably the most outstanding *Alstroemeria* cultivar to be introduced from Mark's program was 'Sweet Laura' (Fig. 6, 7), patented in 1997. 'Sweet Laura' is a sterile triploid that resulted from the PhD work of Chunsheng Lu who crossed the Brazilian species, *A. caryophyllaea*, with the Chilean species, *A. aurea*. *A. caryophyllaea* is the only *Alstroemeria* species that has fragrance. *A. aurea* originates from the colder, southern part of Chile and is cold tolerant and has long flowering stems. The successful crosses from these species produced a hybrid plant that is fragrant, winter hardy to USDA zone 5 and everblooming in the garden. The fragrance of this cultivar is subtle and fluctuates in intensity during the day. Often the fragrance is most obvious when the flowers are removed from the plant and placed inside in a vase of water. When 'Sweet Laura' was first developed, it was thought that by doubling its chromosome number with colchicines, the flowers would become larger. However, this increase in size did not occur; instead, the foliage became darker green.

It is often difficult to name new plant introductions, and the UConn team was struggling to identify a name that would reflect the characteristic of fragrance. During this time, Mark's 7-year old niece, Laura Bridgen, was tragically killed in an accident. It seemed appropriate that this new, special plant be named after the beautiful, sweet child whose favorite color was yellow. The new cultivar was called 'Sweet Laura' and to this day is still the only commercial cultivar that is fragrant.

Mark was promoted to full Professor in 1997 and began a non-profit, commercial micropropagation laboratory at the University of Connecticut called ConnectiCulture. The main goal of this project was to train students who were interested in pursuing a career in tissue culture under a "real

world” situation. *Syringa* (lilacs), *Rhododendron*, *Kalmia* (Mountain Laurel), and other woody plants were micropropagated in this laboratory and the funds that were generated were used to pay the students. In 1999, Mark was awarded a Fulbright Fellowship for his second sabbatical leave in Talca, Chile. There he worked with his long-time friend and colleague, Professor Flavia Schiappacasse at the Universidad de Talca. Mark taught a class in advanced plant propagation with the translational assistance of a past student, Doris Ly. He also spent the majority of his time investigating the geophytes of Chile.

In 2002, several major changes occurred in Mark’s professional career. In January he left the University of Connecticut to join the faculty at Cornell University and moved to their Horticultural Research & Extension Center in Riverhead, New York to serve as Director (www.LongIslandHorticulture.cornell.edu). After almost 18 years of teaching, Mark’s responsibilities were now research, outreach, and administration with no traditional teaching. This change in responsibilities allowed Mark to spend more time on research. He began intensive breeding and cultural studies with other Chilean geophytes including *Leucocoryne*, *Conanthera*, *Zephyra*, *Rhodophiala*, and *Pasithea*, while maintaining an active breeding program with *Alstroemeria*. Also in 2002, Mark was elected the US Correspondent for the International Association of Plant Tissue Culture and Biotechnology. In the following year, he was named a Fellow of the International Plant Propagators’ Society, Eastern Region (IPPS), his favorite organization and one in which he has been actively involved since 1981. In 2007, Mark patented and introduced the *Alstroemeria* cultivar ‘Mauve Majesty’ (Fig. 8); this is the first ornamental plant that Cornell University ever patented. ‘Mauve Majesty’ is an exceptional cultivar that produces strong, upright flower stems throughout the growing season. *Alstroemeria* ‘Tangerine Tango’ (Fig. 9, 10) will be introduced in 2009.

Mark has always recognized his graduate students as the individuals who did the “real work” in his program. The process of accepting a graduate student was always a very important commitment to Mark because once accepted, the student was considered ‘family’ to him. The following outstanding individuals studied with Mark: Joseph King (MS, 1988), Andrew Brand (MS, 1989), Masood Hadi (MS, 1990), Mark Smith (MS, 1990), Paul Winski (MS, 1991), Christopher Cramer (MS, 1994), Chunsheng Lu (PhD, 1995), Doris Ly (MS finished in 1994 in the UK), Alessandro Chiari (PhD, 1998), Janet Todd (MS, 1999), Nathaniel Petley (MS, 2003), Cyndi

DR. MARK P. BRIDGEN, 2008 HERBERT MEDALIST

Wyskiewicz (MS, 2005), Eduardo Olate (PhD, 2005), Chad Miller (MS, 2004), Elizabeth Kollmann (MS, 2006), and current graduate students Ockert Greyvenstein (MS candidate) and Kendra Hutchins (PhD candidate). Mark also had the opportunity to advise Rodney Eason (MS, University of Delaware) by serving on his committee. Mark participated on Rodney's graduate committee because of his expertise with Chilean plants; Rodney was studying Mediterranean plants of Chile. Rodney and Mark were able to travel to Chile together.

Although Chilean geophytes are still a major part of Mark's research program, he is expanding to other plants in his breeding because many of the bulbs take 4-5 years to grow from seed to a flowering-size plant. As Mark often says: "I'm not getting any younger." New breeding objectives include the development of a yellow-flowered *Cleome* with no thorns and interspecific hybridization of the genus *Plectranthus* for the development of new plants that can be used as potted or garden plants.

During Mark's 24 years as a professor, he has published more than 150 articles in scientific journals, proceedings, and books, and more than 130 articles in professional trade magazines and newsletters. Mark has patented 7 cultivars of *Alstroemeria* and has given countless presentations at scientific meetings and stakeholder groups. Although Mark's friends and colleagues applaud his accomplishments as a teacher and scientist, Mark feels very strongly that his best accomplishments are his children, Devin and Emily. Both of them have grown into happy, intelligent, well-adjusted, and ethical individuals who enjoy life and are willing to work to achieve their goals. They, along with his wife, Margot, are the joy of Mark's life and his proudest undertakings.

Dr. Mark Bridgen, Professor and Director
Cornell University
Long Island Horticultural Research & Extension Center
3059 Sound Avenue
Riverhead, New York 11901 USA
E-mail: mpb27@cornell.edu

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Fig. 1. *Alstroemeria* 'Redcoat'.



Fig. 2. *Alstroemeria* 'Patriot'.

DR. MARK P. BRIDGEN, 2008 HERBERT MEDALIST

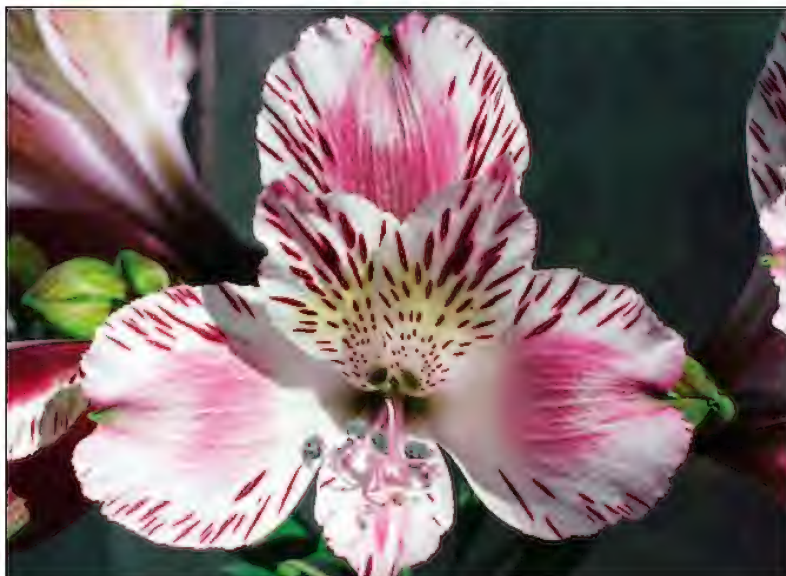


Fig. 3. *Alstroemeria* 'Liberty'.

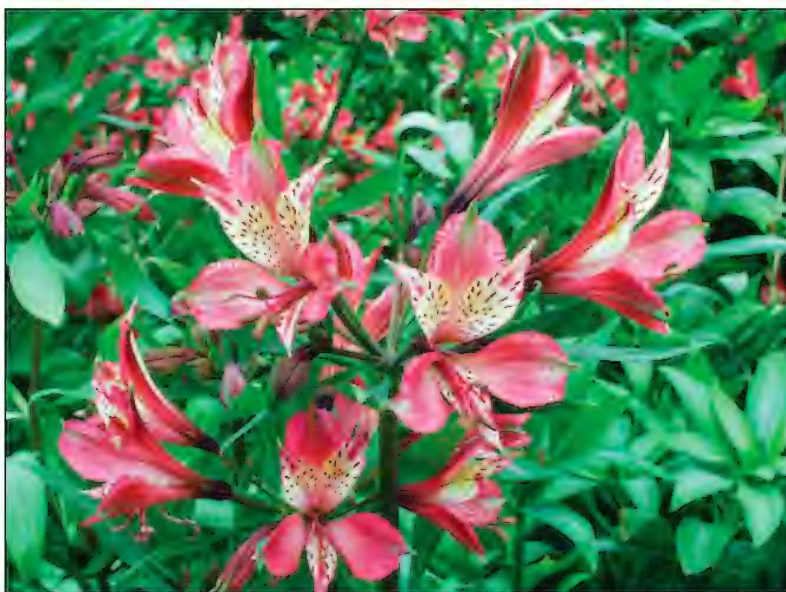


Fig. 4. *Alstroemeria* 'Freedom'.



Fig. 5. *Alstroemeria* 'Patricia Lynn'.



Fig. 6. *Alstroemeria* 'Sweet Laura', the only fragrant commercial cultivar.

DR. MARK P. BRIDGEN, 2008 HERBERT MEDALIST



Fig. 7. *Alstroemeria* 'Sweet Laura'.

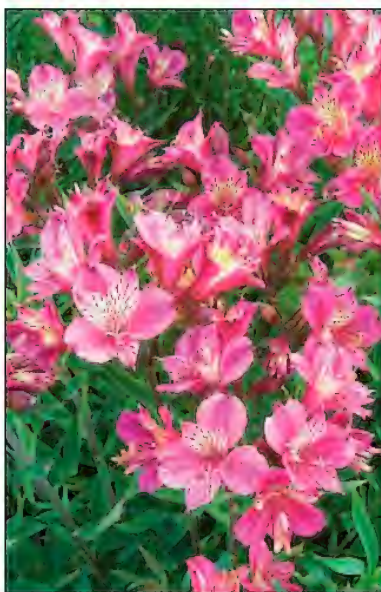


Fig. 8. *Alstroemeria* 'Mauve Majesty'.

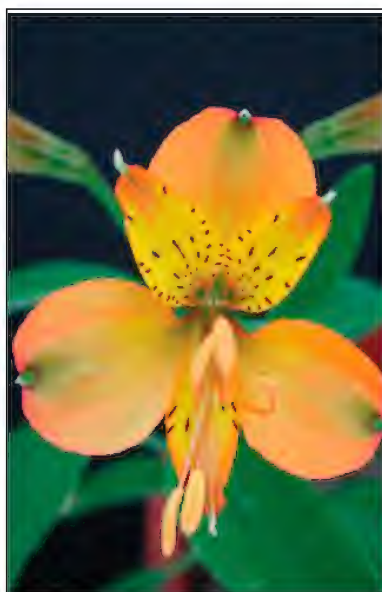


Fig. 9. *Alstroemeria* 'Tangerine Tango'.



Fig. 10. *Alstroemeria* 'Tangerine Tango'.

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THE ONE AND ONLY W.T.D.

AUTOBIOGRAPHY

I was born 92 years ago in Mellette, South Dakota, a wheat farming community. Decades later, during the World War II period I sent for a copy of my birth certificate. The attending doctor at the time of my birth had asked my parents what they were going to name me. My mother replied: "William Tell Drysdale, after my father who was named William after his Scottish father and Tell after his Swiss-mother Elizabeth Tell, from a family of watch-makers in Glasgow, Scotland." His response was: "Oh! You don't want to name him that," and he left blank the space for my name. So I lived the first 25 years of my life having no legal status.

When I was five, we moved to Custer in the Black Hills where my father was engaged as pastor for a non-denominational church. For me, the next five years were sheer heaven. No one could have had a more idyllic childhood. The winters were long and very cold, but my parents and I would walk on moonlight nights on the ice of a frozen stream. I learned classical-music appreciation by playing my father's collection of records on the Victrola. In the summer time there were all kinds of wild flowers, for which I knew all the names. There were a multitude of wild fruits and berries, starting with super sweet wild strawberries and ending with sand plums - the sweetest plums I have ever eaten. When we were thirsty we knelt at the edge of a brook and drank the water. There was lots of space and a light population.

I was just a little tyke at the time because the rooster in question seemed almost as tall as I was. After mowing the lawn Father would turn the chickens loose to eat grass and bugs. One time, I told him the rooster was trying to pick my eyes out. Nothing happened so he must have thought that I had a vivid imagination. Some weeks later when I was out and the chickens were running, I started screaming because the rooster was flying in my face. At our house it was an unwritten law that we had chicken for Sunday dinner. On this occasion we had chicken in the middle of the week.

In those days we had no electrical refrigeration. For ten cents we would buy a block of ice from the ice man for the ice box. It would last three or four days. Ice was stored in an ice barn during the winter. The barn had double walls with sawdust packed in the space between the two walls. Even so, the supply did not last all summer. Milk was delivered daily by the milk man. My father played a minor role in the early "talking stage" of the Mr.

Rushmore Memorial. As a child I found the granite outcrop of rock very impressive.

My heaven was of short duration. In August, my father contacted pneumonia, which in those days was fatal; he died on my birthday. Then my life changed drastically. There were a few pleasant years. In 1929 my mother and I moved to California in August. In October the stock market crashed and the Great Depression began, a ghastly period. This was not a happy time. I transferred from Riverside Junior College to U.C.L.A. in 1936. I went month to month on a shoestring, not knowing which might be my last. My expenses were light. Textbooks were usually in the five dollar range and one could usually sell his textbooks to the used book store. I taught in Los Angeles three years at a private military academy. I had Charlie Chaplain's two boys. Bing Crosby's first family of boys was too young for my classes.

That year was also memorable because it was in September of that year I first encountered *Clivia miniata*, where it was used as a foundation plant on the north side of the Student Book Store. I knew what it was by the seed berries. At that time the Los Angeles Times had the best Garden Section I have ever seen. A single plant was described thoroughly with variants named. *Clivia* became "the" plant in my life. I graduated from U.C.L.A. in 1938 and did post graduate work in order to obtain a General Secondary Certificate, enabling me to teach in high school.

In 1941 the attack on Pearl Harbor brought on World War II. I volunteered and served two and a half years. I was stationed in Upper Assam, India. The base I was assigned to flew aviation fuel over "the Hump" (the Himalayan Mountains to Chendu, China) to the Flying Tigers who were helping General Chiang Kai-shek fight against Mao and his Communist comrades. On occasion there would be seven aircraft stacked at 100 foot separations circling the airport at Kunming. The base at Chabua was surrounded by a magnificent tea plantation far removed from hostilities.

On returning home I taught in Riverside for 30 years, beginning in 1944. I remained inordinately proud of my years of teaching. I never once gave a true and false or a multiple choice test. An essay type test showed whether one was prepared for a test.

I was grateful to Herbert Kelly Jr. for taking me to spend the day with Dr. Hamilton P. Traub in La Jolla in 1983, two days before he died. Dr. Traub was a scholar and an outstanding gentleman. The volumes of Herbertia he edited stood as an accomplishment. Those volumes were rich

HERBERTIA 62 • 2008

memory for research, particularly the biographies which contained information one could find nowhere else. I was particularly fond of the one on Fred Howard, a giant among horticulturists.

In my garden I acquired a good collection of *Crinum* and tried my hand at hybridizing but nothing meritorious emerged. At that time there were a number of *Crinum* devotees in the American Plant Life Society who dabbled in hybridizing but they now seem to be gone with the wind. Unfortunately I am too old to try my hand at the fabulous bloodstreams created by Dr. David Lehmiller; but if I'm around I likely will. I am still dabbling pollen on select plants of *Clivia miniata*.

WILLIAM T. DRYSDALE, 2008 TRAUB AWARDEE

**WILLIAM T. DRYSDALE.****RECOLLECTIONS**

In the spring of 1941, I had volunteered for service during World War II and had been part of a cadre of 50 soldiers sent to Deming, New Mexico. The local people were wonderful, and we all received invitations for Sunday dinners until the numbers simply overwhelmed the town. Deming Air Force Base had grown to staggering numbers.

I really had nothing to complain about, but I longed for something garden wise - a magazine, a book or even a catalog. In my forwarded mail one day a catalog from Cecil Houdyshell appeared. He was a dealer in bulbs and lived in LaVerne, California, not far from Jimmy Giridlian, and he had been awarded the Herbert Medal, an image of which appeared on his catalog. He always carried an introductory "letter" to his customers and urged them to join the American Plant Life Society and receive its publication *Herbertia*. I was already very familiar with this publication since my good friend, Emma Swets, "Riverside's Bulb Lady," had a complete run, which I had borrowed and perused. I ordered the current issue and now have a complete set, but

HERBERTIA 62 • 2008

my initial copy's receipt probably gave me the most joy. I read everything whether I was particularly interested or not. It took me from the rather barren waste of New Mexico to the cultivated life, a gardenist.

Through the publication I became a good friend of Wyndham Hayward, Jimmy Giridlian, Cecil Houdyshell, Les Hannibal, Herbert Kelly Jr., Sheila Thompson - the South African plant collector, as well as May van Eeden, also of South Africa.

Herbertia had opened the door to worldwide sources. In Wyndham Hayward's day, the first thing I read was his article "From the Secretary's Mailbag" to see if there were any unfamiliar sources of bulbs. At the time there was nothing else like it. How long ago that was!

The world into which I was born in 1915 was vastly different from the one in which I now live. To illustrate this I would like to share a little experience with you.

In 1927 President Calvin Coolidge chose the lodge in Custer State Park (South Dakota) to be the summer White House. One day I learned that the President was coming to the railway station in Custer to pick up Leonard Wood, recently Governor General of the Philippines Islands, which was then American territory.

The whole town flocked to the station. Why I was not among them, I have no idea. I waited at the edge of the state highway. In those days major highways went down the main street in towns. Soon I spotted what I was sure was the presidential entourage. It was proceeding at a great rate - surely, over 40 miles an hour. The entire entourage consisted of six people: President and Mrs. Coolidge, their chauffeur and three Secret Service men who rode motorcycles, two in front and one behind the Ford car. That was it. Everyone was at the station. There was not a soul in sight. I waved and "Silent Cal" (nickname) stared straight ahead. I could see his face etched against the far window of the car. Grace Coolidge turned full face and gave me one of her famous smiles and waved vigorously, now of pleasant memory.

The President worshiped Sundays at a church in nearby Hermosa. Anyone could join him and being early was important, because seating was on a first come basis. There was no one to check out the audience. It was all very sedate. There were no activists or protestors but just ordinary citizens. That's the way it was.

*Photographs of William Drysdale by Herbert Kelly Jr.

IN MEMORIAM, THE WILLIAM T. DRYSDALE I KNEW

IN MEMORIAM
THE WILLIAM T. DRYSDALE I KNEW
BORN AUGUST 13, 1915. DIED SEPTEMBER 2, 2008

Herbert Kelly Jr.
 4300 Isabella St.
 Riverside, CA 92501, USA
 E-mail: herbk76@aol.com

I first met William T. Drysdale in the early 1970's on a day when my wife and I had driven to La Jolla, California in order to meet Dr. Hamilton P. Traub, founder of the American Amaryllis Society, antecedent of IBS, and editor of its journal for a half century. (Dr. Traub and I eventually formed a close relationship, and he became a mentor to me in the years to come.) We then drove to Riverside, California to meet Bill Drysdale. We spent the remainder of the day visiting with Bill and enjoying his beautiful garden. It was late in the evening when we started on our journey back to Fresno, California, our home at the time. Little did I realize that this visit with Bill was to be the beginning of one of the most cherished relationships I was ever to have. I shall always be indebted to the late Les Hannibal for introducing me to Bill Drysdale.

Bill was one of the most knowledgeable horticulturists with whom I have had the good fortune to be associated. His vast knowledge of so many plants was unsurpassed by few. People looked forward to his arrival wherever he went, because of his positive attitude and his constant sense of humor. Bill introduced many new plants to the gardening world. He found many plants thought to be lost and helped to reintroduce them. One most notable introduction was the Calla lily, *Zantedeschia aethiopica* 'Green Goddess', which he named and introduced circa 1949–1950. He had selected it from a batch of seed sent to him from South Africa. Bill also found a *Canna* brought into the port of San Diego by a Commodore Bauman, and he grew it for about 15-20 years. He then shared it with me, and I gave it the tentative name of *Canna* 'Panache'. I began propagating it until I had several hundred, and then I distributed this new treasure at home and abroad. It has become one of the most desirable cannas in existence.

Another plant Bill helped to introduce was *Crinum* 'Emma Jones'. This bulb was sent to Bill by Dr. Thad Howard of San Antonio, Texas. Bill had ordered something else from Thad's mail order business, so this bulb had

been sent in error. Thad was visiting Fred Jones one day and Fred gave Thad a bulb of a new *Crinum* hybrid he had created. It was a cross between *Crinum* 'Cecil Houdyshel' x *Crinum* 'Peach Blow'. Thad took it home, evaluated it, and told Fred that it was "a very nice hybrid!" Thad suggested to Fred that he name it *Crinum* 'Emma Jones' after his wife. This is how the name *Crinum* 'Emma Jones' came to be. When Bill received it, he contacted Thad to tell him this was not what he had ordered, but how wonderful it was. Bill dug up his entire stock of 40 bulbs and gave them all to me to propagate and to distribute through my nursery, Kelly's Plant World. I propagated the original 40 bulbs until I had about 250, and then I began distributing them. They are now in cultivation throughout the world.

Bill was also a prolific writer; his list of botanical and horticultural publications was impressive. In addition to his contributions in *Plant Life/Herbertia*, he published many articles in the *Journal of the Bromeliad Society*, the *Newsletter of the University of California Riverside Botanic Gardens*, and the *Journal of the Magnolia Society*. Frequently he published articles in the newspapers of Riverside, California, the city he loved so much. Bill left me many unpublished manuscripts as memoirs, which I will publish in his name as time permits. Bill was one of the oldest and longest serving members of IBS; he joined in 1941, faithfully paying his dues until his passing.

The horticultural world is a richer place because Bill lived, and my life has been enriched by his presence. He has left a legacy through the plants he shared, and through the kindness and generosity he so unselfishly extended to others on his journey through life. He loved his garden, his plants, and life with a passion. THANK YOU SO MUCH, BILL. YOU WILL BE MISSED BY MANY, BUT NEVER FORGOTTEN.

Editor's Note: Bill served on the IBS Awards and Recognition Committee for a number of years. He felt highly honored that the remainder of the Committee had selected him as the 2008 Traub Award Recipient. President Herbert Kelly Jr. conducted a small ceremony in Riverside, California on April 6, 2008, to award him his Traub Award, at which time he was provided with copies of the photographs and the write-up as it would appear in this issue of *Herbertia*. Sadly he did not live long enough to see it actually published.)

NARCISSUS X MORONENSIS KNOCHE (AMARYLLIDACEAE)

***NARCISSUS X MORONENSIS* KNOCHE (AMARYLLIDACEAE),
A NEW AUTUMN FLOWERING *NARCISSUS* HYBRID FROM
SOUTHERN SPAIN**

Gerd Knoche

Friedrich-Ebert-Strasse 52 a

D-42719 Solingen, Germany

E-mail: karl-gerd.knoche@t-online.de

ABSTRACT

Narcissus x moronensis Knoche, a new natural hybrid of *Narcissus cavanillesii* Barra & Lopez and *Narcissus serotinus* L.(s.str.), found in the Sierra de Esparteros (Province Sevilla) is described. Morphological characters and differences to the parents and *Narcissus x perezlarae* Font Quer are defined as well. A chromosome count and flow cytometric measurements of nuclear DNA content are presented.

KEYWORDS: Amaryllidaceae, *Narcissus*, hybrid, chromosome count, DNA value.

INTRODUCTION

At the end of October 2006, within an extensive sympatric population of *N. serotinus* L. (Fig. 1) and *N. cavanillesii* (Fig. 2, 3) at the western end of the Sierra de Esparteros south of Moron de la Frontera, a relatively small number of hybrids between the parents were spotted (Fig. 4, 5, 6). At first glance, the size and shape of their flowers were difficult to distinguish from *N. cavanillesii* (Fig. 7). Closer inspection revealed paler coloured petals that were also a little wider; a more pronounced tube, and above all, considerably shorter stamens. It became very clear that these bulbs did not correspond with the description of *N. x perezlarae* Font Quer (1927), as might normally be expected to result from a combination between the aforementioned parents.



Fig. 1. *Narcissus serotinus*. (All photographs by the author.)

NARCISSUS X MORONENSIS KNOCHE (AMARYLLIDACEAE)



Fig. 2. *Narcissus cavanillesii*. Group of flowering plants.



Fig. 3. Two flowers of *Narcissus cavanillesii*.

DESCRIPTION

***Narcissus x moronensis* Knoche, hybr. nov.**

Hybrida inter Narcissus cavanillesii Barra & Lopez *et* *Narcissus serotinus* L. (*s. str.*).

Diagnosis: *Taxon hybridogenum haec Narcissus cavanillesii similis sed pallidore colore perianthii (luteopallidus in hybrida, luteus in N. cavanillesii). Hybrida tubo articulatore et staminibus brevioribus.*

Hybrid similar to *N. cavanillesii* Barra but the perianth colour paler (pale yellow in hybrid, yellow in *N. cavanillesii*). The hybrid with a more pronounced tube and shorter stamens.

Etymology: Referring to the Sierra de Morón, another name for the Sierra de Esparteros.

Description: Bulb 10-15 mm in diameter, brown, ovate. Scape 50-100 mm, elongating after flowering, round, green. Leaves not present on flowering plants or rarely just emerging. Spathe 12 mm long, membranous. Pedicels 6

NARCISSUS X MORONENSIS KNOCHE (AMARYLLIDACEAE)



Fig. 4. *Narcissus x moronensis*.



Fig. 5. *Narcissus x moronensis*.



Fig. 6. *Narcissus x moronensis*.

NARCISSUS X MORONENSIS KNOCHE (AMARYLLIDACEAE)



Fig. 7. Left: *Narcissus x moronensis*. **Right:** *Narcissus cavanillesii*.

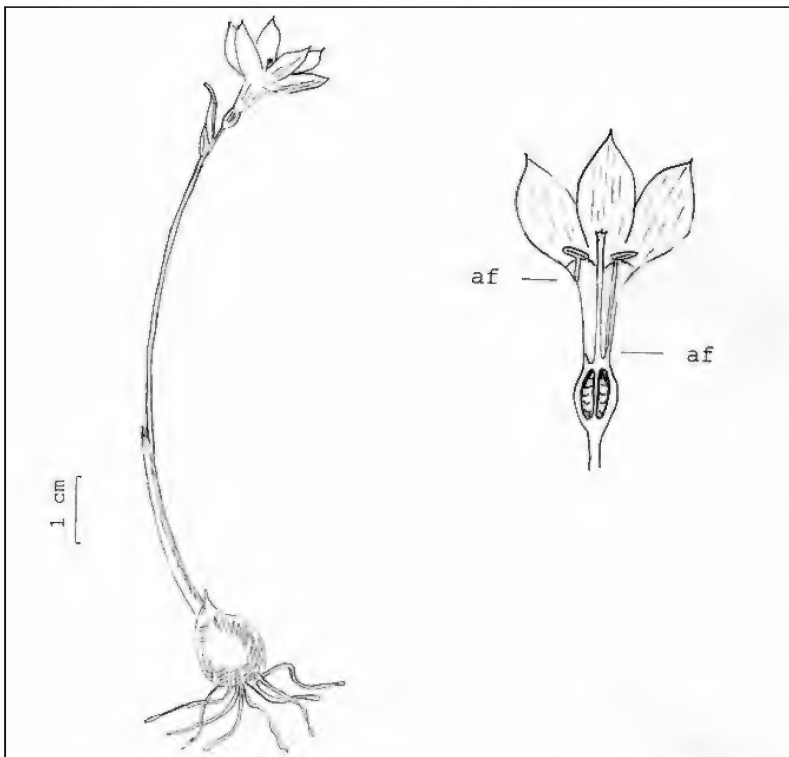


Fig. 8. Left: *Narcissus x moronensis* Knoch, hybr. nov. **Right:** Flower details, longitudinal section, showing position of style, anthers and adnation points of filaments. (Illustration by Gerd Knoch.)

mm long. Tube 4-5 mm long, funnel shaped, yellow with green veins running towards the tepals. Flowers ascending, c. 18 mm in diameter, one per scape. Tepals pale yellow, oblong, mucronate, 3 x 10 mm. Corona 0.5-1 mm high consisting of six lobes. Anthers uniserrate, only slightly overtopping base of the tepals. Filaments attached to the tube in two alternate ranks, 3 attached to the base of the tube, the others to the upper third. Style 0.9 mm, overtopping anthers. Capsule not present. (Fig. 8)

Holotypus: **SPAIN**. Sevilla Province: Sierra de Esparteros (Sierra de Morón), 300 m, 37°04'46.01N, 5°30'52.50W, with both parents on lower part of the Sierra, dry rocky hillside near road A 361, Morón de la Frontera to Montellano, between km 24 and 25, October 1, 2007, Knoche **1004** (OSBU).

DISCUSSION

A hybrid between *Narcissus serotinus* and *Narcissus cavanillesii* was described as early as the end of the Nineteenth Century and specified by Pérez Lara (1882) as *Carregnoa dubia* (Fig. 9). This new found taxon was illustrated by Willkomm (1881-1892) and ultimately named *Narcissus x perezlarae* by Font Quer (1927). At that time this plant was known solely from three specimens initially found at the type locality near the Ermita del Mimbral (Province of Cádiz), nowadays more or less flooded by the waters of the Embalse de Gudalcacín. Since then disjunct occurrences of the hybrid have been noted from the Alentejo in southern Portugal to Valencia in the east of the Iberian Peninsula and in northern Morocco (Marques et al., 2005; 2007).

Recently Donnison-Morgan et al. (2005) reported that some southern Spanish forms of *Narcissus serotinus* carried distinctly different morphological and cytological characteristics that were unlike those found in other parts of Morocco, Portugal and Spain. It was recognized that these two forms were different species. So a new concept was presented which contained *Narcissus miniatus* Donnison-Morgan, Koopowitz & Zonneveld, sp. nov. (Fig. 10) as a new name for the southern Spanish plants that was previously confused with *N. serotinus*. In this paper the authors wrote that *N. x perezlarae* Font-Quer could not be regarded as a hybrid between *N. serotinus* L.(s.str.) but rather the cross between the above-mentioned *N. miniatus* and *N. cavanillesii*, and therefore the name *N. x perezlarae* (Font Quer) Donnison-Morgan, Koopowitz & Zonneveld should be used. Furthermore, the authors mentioned the need for modifying the names of some natural hybrids, which originated from crosses of *Narcissus serotinus* with other co-occurring

NARCISSUS X MORONENSIS KNOCHE (AMARYLLIDACEAE)

Narcissus species, and - “hybrids between *N. serotinus* L. with either *N. viridiflorus* or *N. cavanillesii* are possible and if they should be found they will require new names” (Donnison-Morgan et al., 2005, p.24).

Even though some authors realized that there was a wide morphological variability in some populations of *N. x perezlarae* (Valdés and D. & U. Müller-Doblies, 1984; Marques et al., 2007), until now it was not realized that those remarkable differences may as well be the result of a cross of *Narcissus cavanillesii* with either *N. miniatus* or *N. serotinus* (s.str.). Because of the absence of the original herbarium sheets, Valdés and D. & U. Müller-Doblies (1984) specified a neotype for *N. x perezlarae* (Pastor & Valdes SEV 79777). It was stated that this specimen was equivalent to *Carregnoa dubia* as described by Perez Lara in 1882 and Willkomm (1881-1892). For one of the parents of this neotype they presented and illustrated in detail a type specimen of the flower and a chromosome count of $2n = 30$ which may be valid for *N. miniatus* but not for *N. serotinus* (s.str.). For the neotype a chromosome number of $2n = 29$ was given.

In January 2008 root tips of *Narcissus x moronensis* were sent to Professor Ingo Schneider, Institute for Biochemistry and Biology of the University of Potsdam. A chromosome count resulted in $2n = 19$, the consequence of a haploid set $n = 5$ from *N. serotinus* (s.str.) and 14 from *N. cavanillesii*.

A further confirmation of a new hybrid combination was supported by flow cytometric measurement of nuclear DNA content in picograms (pg) by Dr. Ben J. M. Zonneveld, Institute of Molecular Plant Sciences at Leiden University (method described in Donnison-Morgan et al., 2005, p.21), performed November 2007/April 2008. The results were:

<i>N. serotinus</i>	ex Sierra de Esparteros	20.4 pg
<i>N. cavanillesia</i>	ex Marchena/Sevilla Province	34.7 pg
<i>N. x moronensis</i>	ex Sierra de Esparteros	28.0 pg
<i>N. x perezlarae</i>	ex Medina Sidonia/Cadiz Province	40.7 pg

The intermediate DNA value of *N. x moronensis* was quite evident and clearly different from *N. x perezlarae*. The result of 20.4 pg for *N. serotinus* corresponds more or less to 20.9 pg for two Portuguese provenances of the same species (Donnison-Morgan et al., 2005, table 2, p.22). Measuring nuclear DNA content by flow cytometry has proved to be a useful method to delineate a putative pairing between species with distinct DNA values (Zonneveld et al., 2003).

Investigations concerning the fertility of *Narcissus x moronensis* have not been made, but the hybrid is assumed to be infertile because of the chromosome number obtained. It might well be possible that the hybrid combination described here is not restricted to the Sierra de Morón alone, as it may have happened in other sympatric populations of the accordant parents.

For *Narcissus serotinus* a chromosome number of $2n = 20$ has been determined. That implies theoretically an occurrence of fertile offspring from hybridisation of this species with *N. cavanillesii* which has $2n = 28$ chromosomes. Further studies of known populations with crosses and backcrosses between *Narcissus serotinus* and *N. cavanillesii* would be desirable.

CONSERVATION

Extensive parts of the Sierra de Morón are used as limestone quarries (Aldea de las Caleras de la Sierra) which are dangerously close to the habitat of the daffodils discussed here. Other apparent hazards are unregulated waste disposal and overgrazing. The detection of a new daffodil hybrid clearly points to an existing unique flora, and hopefully this will add support to existing efforts for more effective protection of the remaining, so far relatively unspoiled parts of the Sierra.

ACKNOWLEDGEMENTS

I would like to thank H. J. Müllenborn from Wuppertal for his help with the Latin diagnosis and Drs. Ingo Schneider and Ben Zonneveld for their valuable information and test results.

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NARCISSUS X MORONENSIS KNOCHE (AMARYLLIDACEAE)



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NARCISSUS X MORONENSIS KNOCHE (AMARYLLIDACEAE)



Fig. 10. *Narcissus miniatus*.

TABLE 1. Diagnostic morphological characters for *Narcissus x moronensis* and related species. Data compiled from Valdés and D.&U. Müller-Doblies (1984), Valdés (1987), Donnison-Morgan et al. (2005), and data from this study.

Species	Colour of tepals & corona	Anthers	Tube Length
<i>N. x moronensis</i>	pale yellow	slightly exserted	4-5 mm
<i>N. x perezlarae</i>	tepals pale yellow fading to white corona pale yellow	slightly exserted	5 mm
<i>N. cavanillesii</i>	medium yellow	widely exserted	2 mm
<i>N. serotinus</i> (s.str.)	tepals white corona yellow	slightly exserted	14.5 mm

Species	Corona length	Number of flowers per scape	Scrape height
<i>N. x moronensis</i>	0.5-1 mm	1	* 50-150 mm
<i>N. x perezlarae</i>	1-2 mm	2 rarely 1 or 3	80-220 mm
<i>N. cavanillesii</i>	0.5-1 mm	1 rarely 2 or 3	* 50-100 mm
<i>N. serotinus</i> (s.str.)	1 mm	1 very rarely 2	* 50-100 mm

* Sierra de Morón

AMARYLLIDS OF ISRAEL OVERVIEW, CONSERVATION AND CULTIVATION

Ori Fragman-Sapir
Jerusalem Botanical Gardens
Giv'at-ram
91904 Jerusalem, Israel
E-mail: ofragman@013.net

The flora of Israel consists of more than 2400 native plant species; about 10% are bulbous plants (Fragman et al. 1999). The local richness is a result of the location of Israel at a climatic/continental junction. The *Narcissus* family consists of seven native species and 2 introduced species. In this article I will present all species and discuss their distribution, preservation, and cultivation.

Out of the seven Israeli species, only one (*Narcissus serotinus*) is locally threatened (Sapir et al. 2003); the rest are not threatened on a national scale, appearing in at least dozens of sites around the country. In some cases there are local extinctions, mainly in urban or industrial areas. Most of the local Amaryllids are protected by the Israeli law due to their ornamental value (Fragman-Sapir, 2006).

Cultivation of all 7 local species is rather easy, and at the Jerusalem Botanical Gardens we grow all in sustainable populations that function as backups to specific populations as well as for education and research purposes. Ex-situ conservation is well established now in many botanical gardens around the world (Guerrant et al. 2004). The Amaryllids of Israel demonstrate a positive test case for ex-situ conservation at our gardens. This is in contrast to many other plant groups that are hard to maintain ex-situ for long periods of time.

Narcissus tazetta (Fig. 1, 2, 3)

This is the commonest *Narcissus* species in Israel and in the whole Mediterranean. The local variety has white perianth lobes and a yellow corona. It is primarily a Mediterranean species occurring in two habitat types: rocky slopes where it blooms mainly during December, and in inundated lowlands where it blooms mainly during January (Arroyo & Dafni, 1995). The latter is under threat due to urbanization, industrial development, and modern agricultural practices of deep plowing and herbicide spraying. In the outskirts of Tel-Aviv one can find an impressive population



Fig. 1. *Narcissus tazetta*, Coastal Israel, at the Ayalon Highway fields north of Tel-Aviv, Jan. 5, 2008.



Fig. 2. *Narcissus tazetta*, Coastal Israel, at the Ayalon Highway fields north of Tel-Aviv, Jan. 5, 2008.

AMARYLLIDS OF ISRAEL OVERVIEW, CONSERVATION AND CULTIVATION



Fig. 3. *Narcissus tazetta*, Coastal Israel, at the Ayalon Highway fields north of Tel-Aviv, Jan. 5, 2008.

along the Ayalon highway; the plants grow here in a wheat field, but they are under immediate threat due to local urbanization plans. It is a typical battle case between the real estate sharks together with the municipalities against the green movements.

At any rate, it is clear these two types of populations (rocky and low-lands) are evolving in front of our eyes into future separate species.

Interesting populations of this species occur in Israel as relict ones in the Negev Desert Highlands, which are geologically the continuation of the main Mediterranean mountain ridge of northern and central Israel. Several disjunctive populations occur here at the altitude of 400-700 m. They are probably relicts from colder times during the last ice age. They survive in the cracks and surroundings of smooth rock outcrops that contribute substantial additions of rain water to the plants. In this kind of habitat one can find many other Mediterranean as well as Irano-Turanian bulbs and other plants that are able to maintain viable populations in this special semi-desert condition.

Besides the native populations, it is important to mention that *Narcissus tazetta* is a common, commercial ornamental grown in Israel; the bulbs are distributed in Israel and mostly exported. The important varieties and subspecies are: *Narcissus tazetta* var. *chinensis*, *Narcissus tazetta* 'Constantinopol', *Narcissus tazetta* ssp. *aureus* and *Narcissus tazetta* 'Avalanche'. Beyond these, *Narcissus tazetta* was used to improve some of the *Narcissus papyraceus* varieties.

Narcissus serotinus (Fig. 4, 5)

A coastal species occurring in rocky habitats around the whole Mediterranean. This species occurs along the rocky coasts of the Mediterranean. In Israel it is rare and endangered; one of the 'red' species of Israel (Sapir et al. 2003). It is vulnerable due to two reasons: 1) Most of the Israeli coasts are sandy, so its rocky habitat is rare from the start; 2) It grows only in the heavily developed coast. Many of its southern populations in the area of Hadera, Pardes Hana and Binyamina are already extinct. A bit further north, in the Carmel coastal region there are several huge populations, some of which occur together with *Narcissus tazetta*. In very rare occasions one can find hybrids between the two species. Over the years we collected samples of several populations of this species; we grow them successfully at the Jerusalem Botanical Gardens. Self maintained populations are established at the Mediterranean and Asian sections of the gardens. These popu-

AMARYLLIDS OF ISRAEL OVERVIEW, CONSERVATION AND CULTIVATION



Fig. 4. *Narcissus serotinus*, Coastal Israel, Nahal Tanim Reserve, Nov. 20, 1991.



Fig. 5. *Narcissus serotinus*, Jerusalem Botanical Gardens (rescued from a building site in Binyamina), Nov. 29, 2007.



Fig. 6. *Sternbergia cluisiana*, South Israel, Northern Negev Desert, Lehavim, Nov. 10, 2006.



Fig. 7. *Sternbergia cluisiana*, South Israel, Northern Negev Desert, Lehavim, Nov. 10, 2006.

AMARYLLIDS OF ISRAEL OVERVIEW, CONSERVATION AND CULTIVATION



Fig. 8. *Sternbergia cluisiana*, South Israel, Negev Desert, Yerucham, Oct. 27, 1997.



Fig. 9. *Sternbergia colchiciflora*, Jerusalem Botanical Gardens, Nov. 28, 2007.

AMARYLLIDS OF ISRAEL OVERVIEW, CONSERVATION AND CULTIVATION



Fig. 10. *Pancratium maritimum*, Coastal Israel, Michmoret, Sept. 13, 1992.



Fig. 11. *Pancratium maritimum*, Coastal Israel, Cesarea, Sept. 15, 2006.

lations are easily established since there is a high rate of vegetative reproduction in addition to seeding. We found this species hardy enough for Jerusalem.

Narcissus papyraceus

The third *Narcissus* species of Israel is not native. This West Mediterranean species is grown in huge quantities for export, as well as for the local market. The bulbs are planted in autumn-early winter and produce nice clumps of white flowers in Israel and elsewhere. In the fields around the town on Kiriat Gat and southwards (southern coastal plain), one can often find *Narcissus papyraceus* aftermath in the surroundings of planted fields. This species, originating in similar Mediterranean areas, survives for years in the area, often in fields where it was once planted, but now used for other crops.

Sternbergia cluisiana (Fig. 6, 7, 8)

This is definitely one of the striking wild flowers of Israel and the Middle East. Its huge hysteranthous flowers emerge before leaves and before the rains to amaze nature lovers every year. The flower's ovary is located underground or around ground level during blooming. It is elevated much later when it fruits. Leaves appear in December after the rains. They are coiled and mostly erect. The species occurs mainly along the Fertile Crescent of the Middle East from Israel and Jordan, through Lebanon and Syria to South Turkey, North Iraq and West Iran. In Israel it grows in several dozen disjunctive populations around the country. Often it is found: 1) Associated with *Poterium* (*Sacropoterium spinosum*) in open rocky slopes of the transition zone between the Mediterranean region and the desert; 2) Several populations are found within the arid parts of the Mediterranean area (again with *Poterium batha*); 3) The arid most locations are rare, within the semi-desert, in rocky outcrops that direct water flow to the plants found within them or under them, and here it is found together with *Chiliadenus iphionoides*, *Artemisia herba-alba* shrublets and *Urginea maritima*; 4) It is also found in montane locations, within open steppe forest and tragacanthic batha. To summarize its exciting local distribution, we can see that it grows in the Negev Desert Highlands, East Judea, East Samaria, E Galilee, Golan Heights and Mt. Hermon. Altitude varies from 150 m. to 2,200 m. The species was thought to be extremely rare, and thus became a protected species. These days it is clear that it is not under threat on a national scale, but locally it almost disappeared from the Jerusalem area due to urbaniza-

AMARYLLIDS OF ISRAEL OVERVIEW, CONSERVATION AND CULTIVATION



Fig. 12. *Pancratium sickenbergeri*, South Israel, West Negev Desert, Nizzana Sands, Mar. 17, 2007.



Fig. 13. *Pancratium sickenbergeri*, South Israel, North Negev Desert, Mamshit Sands, Oct. 27, 1997.

HERBERTIA 62 • 2008



Fig. 14. *Pancratium sickenbergeri*, South Israel, West Negev Desert, Shunra Sands, Oct. 21, 2002.

tion. One population existed on the other side of the Jerusalem Botanical Gardens hill (Giv'at Ram), and in the 1980s most of it was transplanted into the botanical gardens, while a school and a highway were built in the original site. The population is thriving and is a successful example of an ex-situ conservation project. In the blooming season (November), the project is exposed to many thousands of our visitors – children and adults alike. This is also an opportunity to invite the *Herbertia* readers to visit the Jerusalem Botanical Gardens and enjoy this magnificent flower.

***Sternbergia colchiciflora* (Fig. 9)**

Unlike most of the *Sternbergia* species, this one has an extremely wide distribution (Spain in the west to the Himalayas in the east). It is a miniature, autumnal bulb; in Israel it has sub-synanthous leaves. In Armenia and other locations the leaves are hysteranthous (Gabrielian & Fragman-Sapir, 2008). In Israel it blooms in late November to early December. This species was thought to be extremely rare in Israel, but we found it in dozens of sites in the north part of the country, mainly on volcanic soils of East Galilee, the Golan Heights and on chalky or sandy soils in the lower parts of Mt. Hermon. Interestingly it was found only once in central Israel (Mt. Hatayasim, in hard limestone). So eventually we tagged this species as rare but not threatened. Recently we discovered that in dry years many plants bloom underground, are self-pollinated, and only much later the fruit appears above ground (Sh. Bekermann & O. Peri, pers. Com.). This exciting ability was recorded in the past (Ruksans, 2007). Ruksans wrote that it was recorded much earlier in 1926 in the Journal of the Botanical Russian Society. The underground flowering and the plant's small size are reasons for the rather few observations found.

Sternbergia lutea

A Mediterranean, hysteranthous species. The flowers are a bit smaller compared with *Sternbergia clusiana*, and the ovary is located just below the perianth segments, much above ground. Although included in Flora Palaestina, it is now clear that this is a garden plant, often found in gardens of monasteries and churches in the vicinity of Jerusalem.

Pancratium maritimum (Fig. 10, 11)

This is a famous Mediterranean, coastal species that occurs along the whole Mediterranean coast of Israel. It is a protected species, frequent but lately decreasing due to touristy and industrial developing. Although primarily an autumn flowering species, blooming starts already in July and finishes in October. The leaves are mostly erect and twisted, mostly disappearing in summer, occurring again in winter. In cultivation this plant will produce dense clumps and will resist summer moderate irrigation. Under summer irrigation regime the leaves will remain throughout the year, also in blooming time. After blooming, fruit develop rapidly and triangular large coaly seeds are dispersed. Some of the seeds germinate during November-December near the mother plants, but many are blown by the wind to the sea, float and reach new locations where they may establish. We recommend the use of this bulb as an ornamental in coastal developed sites (beaches, factories etc.), where sometimes it is practiced successfully (Tel-Aviv coast). *Pancratium maritimum* is a fine Mediterranean garden, water-wise plant; recently bulbs are available in the local gardening market. At the Jerusalem Botanical Gardens the plants flourish and bloom in different, heavier soils, at the altitude of 750 m. Unfortunately, porcupines love them as well.

Pancratium sickenbergeri (Fig. 12, 13, 14)

This is the desert vicariant of *Pancratium maritimum*. It is rather frequent in the sandy desert, occurring in disjunctive large populations throughout the Negev Desert. Nevertheless it is protected. Impressive populations occur in the Shunra sands south of the city of Beer-Sheva and in sandy areas around the town of Dimona. Small populations occur also in the sandy areas of the Arava Valley in extreme desert conditions; these plants bloom rarely, only in rainy years. We found this species to be common also in sandy Wadi Rum in South Jordan.

In general it is a smaller version of *Pancratium maritimum*. The flowers are smaller and the leaves are narrower. The most prominent feature of this species is the coiled (not twisted) leaves, definitely an adaptation to the arid conditions – decreasing water evaporation (parts of the leaf are shaded constantly). It is unclear whether this feature is genetic; some plants develop twisted leaves under Mediterranean conditions. Interestingly, this species also has light, floating seeds, pointing to the fact that it is probably originating in coastal habitats, although found inland today. In the desert the light seeds are dispersed to short distances by the wind.

Vagaría parviflora (Syn. *Pancratium parviflorum*) (Fig. 15, 16, 17)

Another protected Mediterranean autumnal bulb. The flowers are small and hysteranthous. Blooming takes place during late September and October. The leaves are dark green with a white mid-vein, and they occur during November. The seeds are very different from *Pancratium* seeds; they are rounded and arillate, and are dispersed by ants. The species is protected, but it occurs in many and diverse rocky locations. It is common in calcified coastal sandstones, but occurs also in moist, shady scrub on hard limestone. In general the species is especially abundant along the coastal plain and in the western mountain flanks of Judaea and Samaria. A disjunctive population occurs on a north-facing cliff in Jebel Maghara in Egypt - northern Sinai (Shmida, pers. Com.). The species occurs northwards in Lebanon, western Syria and Mediterranean Turkey.

It is a lovely plant that produces showy leaf clusters. It will bloom only in sunny situations. But the beautiful foliage is rewarding enough. At the Jerusalem Botanical Gardens we have two populations that increase by seeds, but mainly by vegetative reproduction. It is a great plant for a sunny Mediterranean rock garden. However, it is not available in the market.

ALL PHOTOGRAPHS BY THE AUTHOR.



Fig. 15. *Vagaria parviflora*, Coastal Israel, Ma'agan Michael, Nov. 20, 1991.



Fig. 16. *Vagaria parviflora*, Central Israel, West Judean Mountains, Burma Road, Sept. 21, 1992.



Fig. 17. *Vagaria parviflora*, Coastal Israel, Bitan Aharon, Sept. 28, 1995.

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HERBERTIA 62 • 2008

***PROTOTULBAGHIA* (ALLIACEAE), A NEW MONOTYPIC GENUS FROM
SEKHUKHUNELAND, SOUTH AFRICA**

Stefan Siebert¹, Canio Vosa,
Abraham E. van Wyk and Hardus Muller

¹Author for correspondence

AP Goossens Herbarium, North-West University
Private Bag X6001, Potchefstroom 2520
Republic of South Africa
E-mail: stefan.siebert@nwu.ac.za

INTRODUCTION

Sekhukhuneland, and especially its main mountain range, the Leolo Mountains, is well known for its many endemic plant species. The region is considered one of several local centres of plant endemism in southern Africa (van Wyk and Smith, 2001). This high level of endemism correlates with the geological substrate, specifically norite and pyroxenite (Siebert *et al.*, 2001). Over the past decade a number of new restricted-range geophytes have been described from the Sekhukhuneland Centre of Plant Endemism (Venter & Edwards 1998; Manning *et al.*, 1999; Hankey *et al.*, 2008). The recent addition of a new genus and species, *Prototulbaghia siebertii* (Vosa, 2007), has sparked a renewed interest in this floristic, poorly studied part of South Africa.

The existence of the new taxon was known for some time before being formally named by one of us (CV). It was apparently first noted by botanists during a vegetation survey of Sekhukhuneland in December 1999. On December 4, 1999 – “2000”, as cited in Vosa (2007), was a typographical error — the holotype (van Wyk & Siebert 1304 (PRU)) was collected on the summit of the Leolo Mountains, to date its only known locality. Thereafter, the still undescribed taxon was featured in several publications (Siebert and van Wyk, 2001; van Wyk and Smith, 2001; Siebert *et al.*, 2001; Craib and Siebert, 2002; Siebert *et al.*, 2002a, b; Smale, 2008). In fact, the endemism, threat status and ecology of the taxon were all relatively well documented by the time of its formal description.

However, other than the account by Vosa (2007), the taxonomic status and morphology of the plant has not been published widely. Therefore, the main aim of the present paper is to serve as a follow-up to Craib and Siebert (2002), a contribution which dealt with the autecology of what was referred to at the time as a “new genus related to *Tulbaghia*”. Here we provide a general and less formal description of the new genus and species.

PROTOTULBAGHIA (ALLIACEAE), A NEW MONOTYPIC GENUS FROM SEKHUKHUNELAND



Fig. 1. Seepages on the Leolo Mountain where *Prototulbaghia siebertii* grows profusely. Vast sheets of exposed norite rock are found within the depressions associated with these seepages. When the drainage system becomes inundated in the rainy season, small streams flow over the rock sheets. (Photograph by S.J. Siebert)



Fig. 2. *Prototulbaghia siebertii* grows in humus-rich 'moss islands' on the periphery of the norite rock sheets, in the contact zone between the rock and the seepage. The microclimate of these 'islands' alternate between xeric and mesic depending on the season. (Photograph by S.J. Siebert)

BACKGROUND

Prototulbaghia's status as a possible monotypic genus endemic to the Sekhukhuneland Centre of Endemism was first suggested by Clare and Robert Archer (National Herbarium, Pretoria) and reported in van Wyk and Smith (2001). Subsequently a plea for its conservation as a rare restricted-range taxon under threat was made by Siebert and van Wyk (2001). Population counts during a survey in April 2008, suggested that approximately 3,500 individuals occur in nature. Craib and Siebert (2002) estimated the area of occupancy of this taxon to be 20 km², but the recent survey showed this to be a gross over-estimate. Area of occupancy for the taxon was measured with a Global Positioning System as $\pm 1,600$ m² and the extent of occurrence as ± 5 km².

The habitat of *Prototulbaghia siebertii* is rather unusual in that it may be quite parched during the dry winter months, but in the summer rainy season it becomes more or less permanently wet (Fig. 1). This alternation of very dry and wet periods is proper for certain desert or semidesert regions. Hence, it is no surprise that our species grows together with succulent species such as *Aloe cryptopoda*, *Crassula alba*, *Crassula sarcocaulis*, *Huernia insigniflora* and *Plectranthus neochilus*, as well as xerophytic resurrection plants such as *Myrothamnus flabellifolius* and *Xerophyta viscosa*.

In Siebert *et al.* (2002a), the new genus is erroneously treated as part of the *Limosello maioris*-*Ranunculetum meyeri* plant community of seepages. In reality, *Prototulbaghia siebertii* grows away from these seepages in a unique habitat comprising large islands (± 400 m²) of norite rock sheets at ground level. The run-off from these rock sheets feeds the seepages, and the taxon grows along the edges of the sheets where rock meets the clay soil (Fig. 2). This narrow, rock-fringing plant association still requires formal description.

TAXONOMY

Prototulbaghia siebertii is a small (up to 150 mm tall when in flower), slender, bulbous plant that exudates an alliaceous smell when the fleshy leaves and roots are crushed. The rootstock is a pear-shaped corm on a poorly-defined rhizome. The spreading, shiny, dark green leaves have peculiar hooked tips. Emerging young leaves have coiled tips that unwind, with the coiled portion remaining as thickened hook-like structures in the mature leaves.

Prototulbaghia (ALLIACEAE), A NEW MONOTYPIC GENUS FROM SEKHUKHUNELAND



Fig. 3. *Prototulbaghia siebertii*. Few-flowered umbels are produced on peduncles up to 150 mm long. In any one inflorescence usually a single white flower opens at a time and lasts for a day, after which it closes and fades to pink or magenta. The dried and shriveled remains of older flowers persist below the fruit, or are shed after some time if fruit fails to develop (as in photograph). (Photograph by A.E. van Wyk)



Fig. 4. *Prototulbaghia siebertii*. Although the flowers are predominantly white at anthesis, they may have a slight pinkish tinge, often becoming more intense on the dorsal surface of the outer tepals. (Photograph by A.E. van Wyk)

Fig. 5. *Prototulbaghia siebertii*. The tepals are fused into a very short (2 mm) yellowish green tube at the base. In a fully opened flower the perianth lobes never open flat but remain at a slightly erect angle. The free portion of the larger outer tepals is about 4.5 mm long, 2 mm wide. Note how in the early stages of anthesis the membranous lobes of the pseudo-corona enclose the stamens. (Photograph by A.E. van Wyk)



PROTOTULBAGHIA (ALLIACEAE), A NEW MONOTYPIC GENUS FROM SEKHUKHUNELAND

Plants come into flower just after the start of the summer rains, usually in November. The flowers always face upwards, showing deep yellow anthers, and are quite small, from 5 to 7 mm in length from the tips of the outer perianth segments to their point of attachment to the purplish pedicels (Fig. 3). The flowers are white, often with a pink or purplish tinge (Fig. 4), especially on the outside of the spatulate perianth segments. The spreading outer perianth segments have a central greenish stripe on the lower (dorsal) surface.

Flowers usually open in the morning, but never fully so, remaining somewhat campanulate and fading to deep pink in the late afternoon as they age and close (Fig. 3). When a plant starts flowering, there will be at least one flower open every day for about a week. A flower only lasts for a day. There is then a period of rest lasting a few days and the plant starts flowering again. The flowering season may continue throughout summer (November to March), with an odd plant still flowering as late as April (early autumn).

Winged staminal filaments are quite common in the Alliaceae, especially in the genus *Allium* and in some of the American genera of the family. However, in *Prototulbaghia*, the wings of three of the staminal filaments are unusually enlarged (Fig. 5-7). These petaloid filaments are united with the three other thread-like filaments, forming a pseudo-corona (Fig. 7), which is one of the outstanding features of our plant. Essentially a highly modified staminal tube, this structure is referred to as a pseudo-corona. This is to distinguish it from a "true" corona as in *Tulbaghia*, a more prominent appendage also fused to, and/or derived from, the perianth.

Mature capsules are triangular, mitre-like with the dried up remains of the perianth segments at the base and tipped by the remains of the withered style. The capsules split open along three slits to form a beaker that contains the seed.

WHY A NEW GENUS?

There are some important morphological differences between our plant and *Tulbaghia*, thought to be its nearest generic relative. These differences involve the existence of a pronounced perigonal tube and true corona in all species of *Tulbaghia*, while in *Prototulbaghia*, the perigonal tube is very short (± 2 mm) (Fig. 4) and the pseudo-corona is formed by the winged portion of the three expanded filaments that are fused along their margins to the three simple filaments (Fig. 7). Other differences are to be found in

the arrangement of the stamens. *Tulbaghia* have the stamens in two whorls, one inserted on the perigonal tube just above the stigma and the other more or less near the mouth of the corona. In *Prototulbaghia* the perigonal tube is very short and insignificant, and the anthers are just protruding, together with the stigma, from the top of the united filaments (Fig. 6, 7). These morphological differences clearly separate our genus from *Tulbaghia*.

However, notwithstanding the intergeneric differences as stated above, the pseudo-corona of *Prototulbaghia* is most probably homologous to the true corona as it exists in all species of *Tulbaghia*. Studies on the ontogeny of the flower in *Tulbaghia* have established that the corona derives from an initial dorsal outgrowth of the three inner staminal filaments and subsequent fusion of the latter with their three outer, simple, counterparts. These early developmental events seem to correspond with the mature morphological state in *Prototulbaghia*. The staminal structure of *Prototulbaghia* therefore seems to reflect an evolutionary intermediate stage towards the development of a proper corona as is found in *Tulbaghia*. All this evidence, together with the peculiarity of its habitat and its geographical isolation, tends to further corroborate our preferred hypothesis that *Prototulbaghia* might be phylogenetically basal to *Tulbaghia*. Although it is certainly possible that the floral structure in *Prototulbaghia* may have been derived neotenuously from a *Tulbaghia*-like ancestor, we consider it a less attractive hypothesis.

Tulbaghia galpinii is a morphologically anomalous species from southern Africa, representing a special case which may be noteworthy in our effort to understand the isolated existence of *Prototulbaghia*. *Tulbaghia galpinii* possesses a corona composed of three scarcely-fleshy main lobes, each subdivided into two small acuminate lobes. It is a very small plant with rather thin leaves, restricted to a few localities in the Eastern Cape. Pollination experiments on cultivated material, originally collected in four separate areas, have established that *Tulbaghia galpinii* is self-fertile. This character, which of course promotes inbreeding, seems to have placed this species in a kind of evolutionary *cul-de-sac*, thus perhaps accounting for its persistent "primitive" features such as the thin and deeply lobed corona. *Tulbaghia galpinii* has a relatively short perigonal tube and seems not to have any morphologically close relatives. Its relatively small area of distribution may indicate that it has entered an evolutionary dead-end and is heading for extinction. The parallel with *Protulbaghia* is evident in it having a similar chromosome complement, self-fertility, very restricted geographical range, a peculiar corona, and a short perigonal tube.

PROTOTULBAGHIA (ALLIACEAE), A NEW MONOTYPIC GENUS FROM SEKHUKHUNELAND



Fig. 6. *Prototulbaghia siebertii*. The stamens are surrounded by the pseudo-corona, a membranous structure formed by large, dorsal, wing-like extensions of three of the filaments, these extensions in turn being laterally fused to the remaining three normal filaments. The anthers are borne at more or less the same level and, together with the papillate stigma, extend to the mouth of the pseudo-corona. (Photograph by A.E. van Wyk)



Fig. 7. *Prototulbaghia siebertii*. Centre of flower enlarged, showing the six yellow anthers and style with whitish capitate stigma, all partly surrounded by the membranous lobes of the pseudo-corona (highly modified staminal tube). Photograph by A.E. van Wyk

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SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

S. Venter

Australian Tropical Herbarium
James Cook University
P.O. Box 6811
Cairns, Queensland 4870
Australia
E-mail: fanie68@bigpond.com

INTRODUCTION

The genus *Ledebouria* Roth belongs to the family Hyacinthaceae (Dahlgren et al. 1985). The distribution of the genus includes the African Continent, India and the Island Nossi-Bé on the northwestern coast of Madagascar (Fig. 1). The centre of diversity for the genus is in the Limpopo, Mpumalanga and KwaZulu/Natal Provinces of the Republic of South Africa.

Roth described the genus *Ledebouria* in 1821 with *Ledebouria hyacinthina* Roth, from India, as the type species. This species was transferred to the genus *Scilla* L. and provided the basionym for the largest section of *Scilla* namely section *Ledebouria* (Baker, 1870). Later Jessop (1970) reinstated the genus *Ledebouria* whilst revising the genus for South Africa. The first revision of *Ledebouria* was by Baker (1870) in his monograph of *Scilla*, section *Ledebouria* and the genus *Drimiopsis*. This was followed by a revision of the herbaceous capsular gamophyllous Liliaceae (Baker, 1870a). The most recent revision of *Ledebouria* was by Venter (1993), again only for South Africa with some notes on species further to the north.

The large degree of phenotypic variation in *Ledebouria*, particularly with regard to habit and leaf maculation, has resulted in the publication of 102 species in four different genera. This led to numerous combinations and changes throughout the taxonomic history of the genus. As a result the species concepts were a source of considerable nomenclatural and taxonomic confusion.

Manning et al. (2004) revised the sub-Saharan Hyacinthaceae based on a molecular phylogenetic analysis and based on this study, the *Drimiopsis* Lindl. & Paxton, *Resnova* Van der Merwe and *Ledebouria* clade forms a polytomy in the strict consensus tree and is not further resolved providing no support for more than a single genus. The morphological characters used by Manning et al. (2004) as support for this clade are homoplasious or symple-

siomorphies (Lebatha et al. 2006) and can hardly be used for including *Drimiopsis* and *Resnova* into *Ledebouria*. These morphological characters are the following 1) Lack of bracteoles – at least 22 species of *Ledebouria* have bracteoles. 2) Globose or top-shaped ovary – six species of *Ledebouria* have ellipsoidal ovaries and *Ledebouria ovatifolia* has a distinct cylindrical ovary. 3) Most species have spotted leaves – in *Ledebouria* alone there are 11 species having only concolorous leaves and nine species where the leaves can either be concolorous or spotted, even in the same population. 4) They often produce more than a single inflorescence per plant in one growing season – in *Ledebouria* alone there are 10 species producing only a single inflorescence. 5) The bulb scales are often rather loosely packed – only six species of *Ledebouria* have bulb scales that are somewhat loosely arranged, the rest have tightly packed bulb scales. 6) Bulb scales producing threads when torn – there are more *Ledebouria* species lacking threads when bulb scales are torn. A wider range and more material need to be analyzed to give a more realistic picture of the phylogenetic history of *Ledebouria*.

SPECIES TREATMENT

Ledebouria Roth

Nov. Pl. Sp.:194 (1821); J.P. Jessop, Journ. S. Afr. Bot. 36 (4):244 (1970); Dyer, Gen. S. Afr. Fl. Plants 2:937 (1983), Manning et al. Edinburgh Journ. of Botany 60(3): 533–568 (2004), Lebatha et al., Taxon 53(3):643–652 (2006).

Eratobotrys Fenzl ex Endl., Gen. Pl., Suppl. 2:13 (1842).

Xeodolon Salisb., Gen. Pl.:18 (1866).

Scilla L. pro parte Baker, Flora Cap. 6:478 (1896); Phillips, Gen. S. Afr. Fl. Plants:191 (1951).

Type species: *Ledebouria hyacinthina* Roth (= *Scilla indica* Baker), from India, Curtis's Bot. Mag. 60:t.3226 (1833).

Plants deciduous or evergreen, solitary to gregarious; roots wiry, contractile, fleshy or fusiform; *bulb* usually subterranean, sometimes epigeal, globose to cylindrical, 10–200 mm diameter, sometimes forming a prominent neck, tunicated or with more or less loosely imbricate scales, scales yellowish brown to purple, sometimes with threads when torn, basal stem occasionally present, 0–120 mm long, *cataphylls* 0–3. *Leaves* 1–20, partly or fully devel-

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

oped at flowering, erect to depressed, sometimes spirally twisted, linear to suborbicular, fleshy or leathery, glabrous to pubescent, green to purple with or without darker green or purple markings. *Inflorescences* 1–10, in succession, each a few to many-flowered raceme, sometimes subspicate, 4–150-flowered; *peduncle* erect or flaccid, smooth or papillate, sometimes marked; *bracts* either small and membranous or fleshy, vestigial or lacking, with or without bracteoles. *Raceme* lax or dense, cylindric to globose; pedicels sometimes vestigial, spreading, 1.0–15.5 mm long. *Flowers* usually nodding, green, purple to pink, rotate to campanulate or subglobose; tepals usually more or less erect below and recurved above, mostly fused at base, linear to oblong, usually dimorphic with inner tepals cucullate and connivent; *stamens* exserted or included, usually free, the outer inserted at base of tepals, the inner higher up, sometimes shorter than the outer, erect or spreading; filaments white, green, pink to purple, base cylindric to slightly flattened; anthers white, yellow or violet, dorsifixed; *ovary* ovoid or turbinate and then 3–6-lobed with a short carpophore, lobes variously shaped, often with swollen, nectar-producing lobules below; ovules (1-)2 per locule; *style* triangular to terete; stigma penicillate. *Capsule* globose to obovoid or clavate, 3-lobed; *seeds* 2 per locule, globose, drop-shaped or disc-shaped, black or brown, testa tightly adhering.

Distribution: Sixty plus species in sub-Saharan Africa, with one or two species each in India and Madagascar. The greatest species diversity occurs in the eastern and central parts of the Limpopo Province and Mpumalanga with 8–14 species per degree square (Edwards & Leistner, 1971). The areas in South Africa with the lowest diversity (1–3 species per degree square) are the Karoo, Namaqualand, Northern Cape Provinces and the Kalahari.

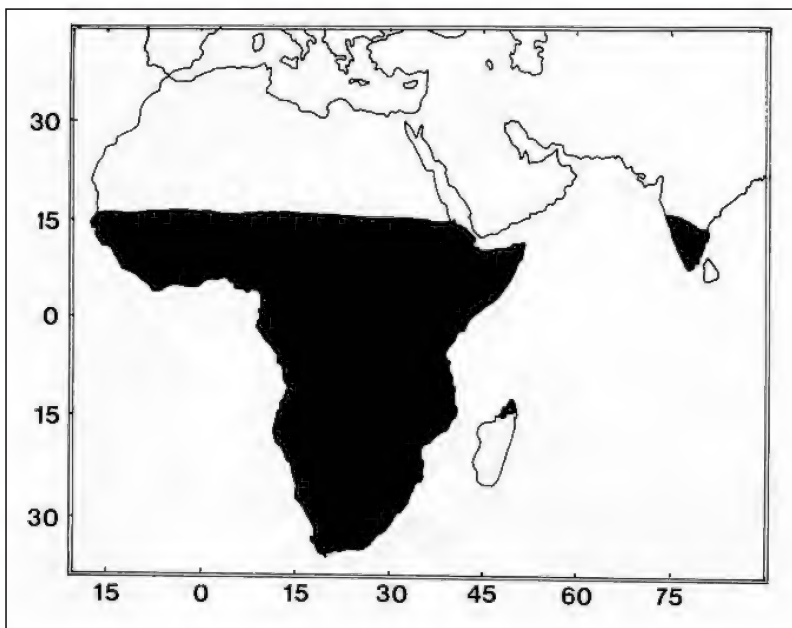


Fig. 1. Distribution of the genus *Ledebouria*.

Key to the species.

1. Bulb epigeal or semi-epigeal (more than 40% above ground)2.
 Bulb hypogeal8.
2. Bulb epigeal3.
 Bulb semi-epigeal4.
3. Inflorescence erect; bracts fleshy; apex of ovary not forming shoulders;
 seed black; Eastern Cape35. *L. socialis*
 Inflorescence flaccid; bracts membranous; ovary shoulders present; seed
 brown; Limpopo Province10. *L. dolomiticola*
4. Inflorescence erect; leaves up to 5 mm wide; ovary shoulders tapering
 into the style; basal part of leaf with crisped margins8. *L. crispa*
 Inflorescence flaccid; leaves more than 15 mm wide; ovary shoulders not
 tapering into the style; basal part of leaf sometimes undulate5.
5. Bulbs cylindrical; flower bracts form a distinct coma in young
 inflorescence9. *L. cremnophila*
 Bulbs globose to ovoid; flower bracts not forming a distinct coma in the
 young inflorescence6.

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

6. Dead bulb scales thin, papery with indistinct abscission layers36. *L. venteri*
Dead bulb scales dry and firm with distinctly ridged transverse abscission layers7.
7. Leaves fully emerged at anthesis, without threads when torn, glossy green; rachis terete, smooth; bracts vestigial4. *L. concolor*
Leaves partly emerged at anthesis; with threads when torn, dull glaucous; rachis flattened at base, ridged; bracts membranous, 0.5-1.0 mm long5. *L. confusa*
8. Inflorescence erect9.
Inflorescence flaccid16.
9. Ovary 3-lobed10.
Ovary 6-lobed12.
10. Bulb scales truncate, with threads when torn; leaf 1 (-2), margin discoloured; rachis ridged; base of peduncle compressed; Limpopo Province and Mpumalanga24. *L. monophylla*
Bulb scales attenuate; without threads when torn; leaves 2 or more, margin concolorous; rachis smooth; base of peduncle terete11.
11. Adaxial leaf surface smooth; leaves without threads when torn; margin smooth; bulb ovoid, bulblets absent; Western and Eastern Cape25. *L. ovalifolia*
Adaxial leaf surface hairy; leaves with threads when torn, margin ciliate; bulb obovoid, bulblets present; Limpopo Province and Mpumalanga ..29. *L. parvifolia*
12. Petiole present27. *L. papillata*
Petiole absent13.
13. Bulb scales with threads when torn14.
Bulb scales without threads when torn16.
14. Adaxial leaf surface hairy; leaves without threads when torn, margins concolorous, fleshy; seed black; NW Province17. *L. lepida*
Adaxial leaf surface smooth; leaves with threads when torn, margin discoloured, leathery; seed brown; widespread15.
15. Rachis smooth; bracts fleshy; bulb scales attenuate; apex of ovary with rounded shoulders; Eastern Cape Province7. *L. coriacea*
Rachis ridged; bracts membranous; bulb scales truncate; ovary shoulders absent; Northern Cape, NW Province and Limpopo Province14. *L. glauca*
16. Rachis smooth; inflorescence longer than leaves; tepals not cucullate ...17.
Rachis ridged; inflorescence shorter than leaves; tepals cucullate ...21.
17. Adaxial leaf surface viscid38. *L. viscosa*
Adaxial leaf surface not viscid18.

HERBERTIA 62 • 2008

18. Basal stem well developed; leaf surface with conspicuous red pits; perianth stellate23. *L. mokobulanensis*
 Basal stem absent; leaf surface lacking pits; perianth with recurved tepals19.
19. Bulb with a prominent neck; adaxial surface glabrous with large prominent purple blotches28. *L. pardalota*
 Bulb without a neck; adaxial surface green or sometimes with dull purple blotches20.
20. Adaxial leaf surface covered in broad papillae up to 0.5-1.0 mm high; leaves 40-60(-90) mm wide; inflorescence 30-70-flowered; rachis ridged30. *L. pustulata*
 Adaxial leaf surface smooth; leaves 18-30 mm wide; inflorescence 12-20-flowered; rachis smooth34. *L. sandersonii*
21. Leaves absent at anthesis37. *L. undulata*
 Leaves present at anthesis22.
22. Petiole present; Mpumalanga Province23.
 Petiole absent; not restricted to Mpumalanga24.
23. Rachis smooth; adaxial leaf surface hairy, without threads when torn; seed brown33. *L. rupestris*
 Rachis ridged; adaxial leaf surface smooth, with threads when torn; seed yellowish-brown31. *L. remifolia*
24. Ovary 3-lobed25.
 Ovary 6-lobed26.
25. Bulb scales truncate, with threads when torn; adaxial leaf surface with lacunae; rachis ridged; ovary shoulders absent; Kaapsche Hoop area13. *L. galpinii*
 Bulb scales attenuate, without threads when torn; adaxial leaf surface smooth; rachis smooth; ovary shoulders rounded; Eastern and Western Cape25. *L. ovalifolia*
26. Bulb scales with threads when torn27.
 Bulb scales without threads when torn35.
27. Leaves spirally twisted28.
 Leaves straight29.
28. Ovary shoulders present; bulb obovoid; leaves leathery, difficult to tear, margin discolorous; widespread21. *L. marginata*
 Ovary shoulders absent; bulb cylindrical; leaves fleshy, easily torn, margin concolorous; NW Province3. *L. atrobrunnea*

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

29. Leaves hairy, margin ciliate; bracts fleshy; tepals lanceolate;
 Eastern Cape15. *L. hypoxidioides*
 Leaves glabrous, margin smooth; bracts membranous; tepals oblong;
 widespread30.
30. Leaves partly emerged at anthesis31.
 Leaves fully developed at anthesis32.
31. Bulb scales truncate; live bulb scales loosely arranged; leaves glossy,
 abaxial surface monochromatic, base canaliculated26. *L. ovatifolia*
 Bulb scales attenuate; live bulb scales tightly arranged; leaves lusterless,
 abaxial surface dichromatic, base flat35.
32. Ovary shoulders present; bulb ovoid, 30-35 mm diameter; bulb scales with promi-
 nent purple blotches; leaf margin discolorous; seed brown16. *L. inquinata*
 Ovary shoulders absent; bulb obovoid, 100-150 mm diameter; bulb scales
 without purple blotches; leaf margin concolorous; seed black33.
33. Seed black; tepals not cucullate; pedicels green; perianth predominantly
 green39. *L. zebrina*
 Seed brown; tepals cucullate; pedicels pink; perianth pink to purple34.
34. Leaves fleshy, glossy, margin concolorous, venation obscure ...32. *L. revoluta*
 Leaves leathery, lusterless, margin discolorous, venation prominent ..19. *L. luteola*
35. Leaves with threads when torn; rachis ridged36.
 Leaves without threads when torn; rachis smooth38.
36. Leaves spirally twisted, partly emerged at anthesis, margin concolorous;
 tepals linear; seed black18. *L. leptophylla*
 Leaves straight, fully developed at anthesis, margin discolorous; tepals
 oblong; seed brown37.
37. Ovary shoulders tapering into the style; bulb ovoid; leaf margin smooth;
 venation obscure12. *L. floribunda*
 Ovary shoulders raised; bulb subglobose; leaf margin papillate; venation
 prominent2. *L. asperifolia*
38. Bracts fleshy39.
 Bracts membranous43.
39. Ovary shoulders present, base of ovary lobes smooth40.
 Ovary shoulders absent, base of ovary lobes papillate42.
40. Ovary shoulders truncate; leaf apex obtuse, venation prominent; peri-
 anth stellate20. *L. macowanii*
 Ovary shoulders tapering into the style; leaf apex acute, venation
 obscure; perianth recurved41.

HERBERTIA 62 • 2008

41. Live bulb scales loosely arranged; dead bulb scales brown; abaxial leaf surface monochromatic; inflorescence longer than leaves34. *L. sandersonii*
 Live bulb scales tightly arranged; dead bulb scales purplish-brown; abaxial leaf surface dichromatic; inflorescence same length as leaves1. *L. apertiflora*
42. Leaves linear to narrowly elliptic; perianth stellate22. *L. minima*
 Leaves lanceolate to oblong; perianth sharply reflexed11. *L. ensifolia*
43. Ovary shoulders present; bulb obovoid, live bulb scales tightly arranged, bulblets absent; leaves elliptic1. *L. apertiflora*
 Ovary shoulders absent; bulb subglobose, live bulb scales loose, bulblets present; leaves lanceolate6. *L. cooperi*

1. *Ledebouria apertiflora* (Baker) Jessop, Journ. S. Afr. Bot. 36(4):254 (1970).

Type: Figure in Saund. Ref. Bot. 1:t.19 (1868), lecto,!. here designated.

Drimia apertiflora Baker, Saund. Ref. Bot. 1:t.19 (1868).

Scilla lorata Baker, Saund. Ref. Bot. 3 (Append.):14 (1870). Iconotype: As for *Drimia apertiflora*.

Scilla linearifolia Baker, Saund. Ref. Bot. 3: t.184 (1870). Iconotype: Saund. Ref. Bot. 3:t.184 (1870).

Scilla apertiflora (Baker) C.A. Sm., Kew Bull. : 250 (1930). Type: As for *Drimia apertiflora*.

Diagnostic Features:

Live bulb scales tightly arranged, dead bulb scales purplish-brown, leaves without threads when torn, abaxial lamina surface dichromatic, inflorescences equaling to longer than leaves, rachis and scape smooth and the apex of the ovary tapering into the style.

Discussion:

Ledebouria apertiflora differs from *L. cooperi* (Hook. f.) Jessop in the absence of bulblets and bracteoles; acute tepal apices, style 1.5 mm long and the ovary 1.2 mm wide. *L. revoluta* (L. f.) Jessop differs in having threads in the leaves and bulb scales when torn, its ridged rachis, wider tepals (± 3 mm) with obtuse apices, longer style (6 mm) and ellipsoidal ovary. Erroneously included in *L. ensifolia* (Ecklon) S. Venter & Edwards (2003).

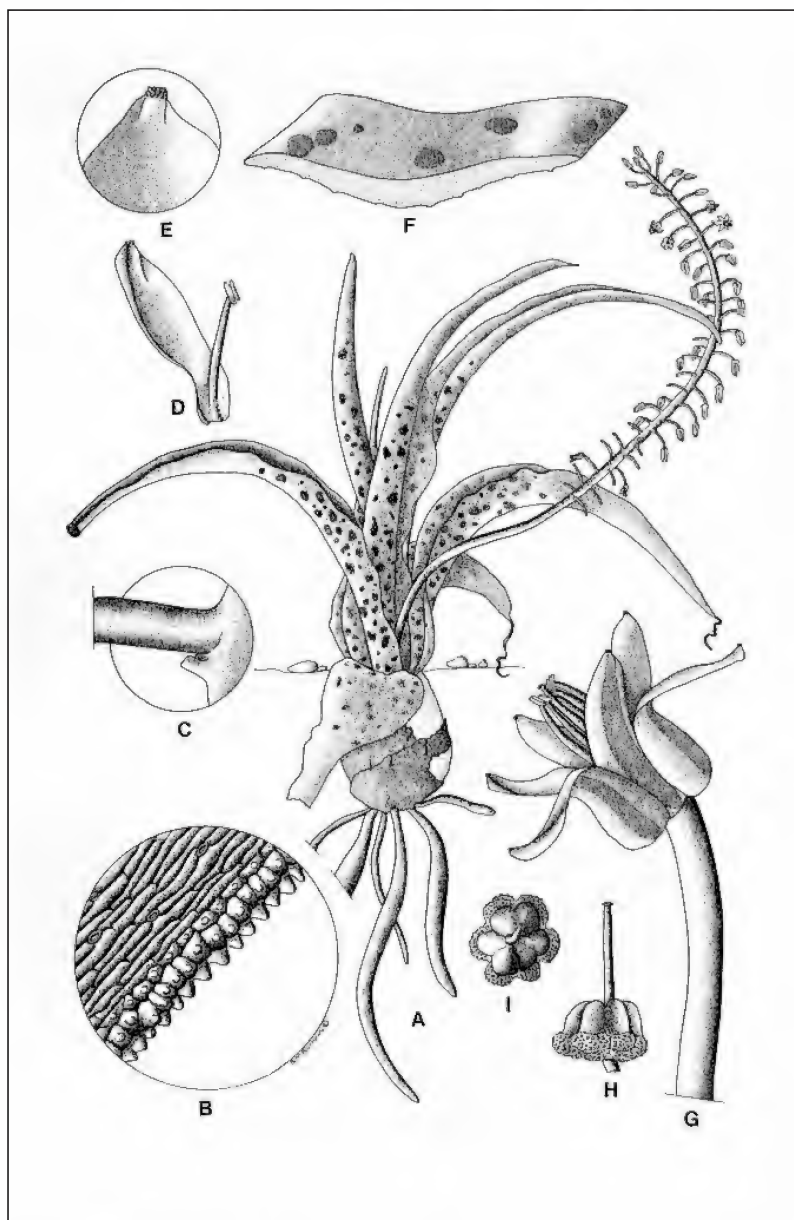
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 2. *Ledebouria apertiflora*. **A**, flowering plant ($\times 0.5$); **B**, leaf margin ($\times 300$); **C**, bract ($\times 10$); **D**, tepal with stamen ($\times 10$); **E**, apex of tepal ($\times 25$); **F**, cross-section through leaf ($\times 5$); **G**, flower ($\times 10$); **H**, gynoecium lateral view ($\times 10$); **I**, gynoecium dorsal view ($\times 10$). Drawn from Venter *s.n.* (UNIN).

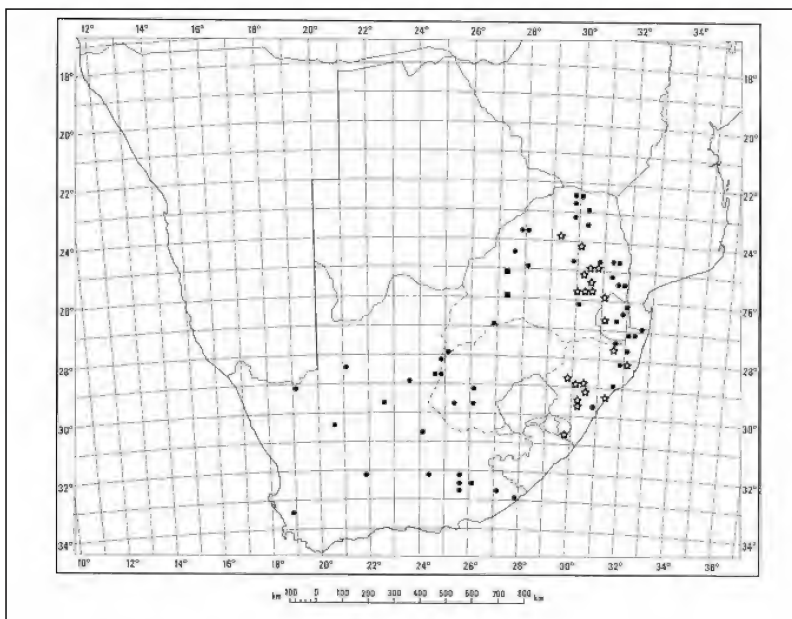


Fig. 3. Known distribution of *Ledebouria apertiflora* (solid circles), *L. asperifolia* (stars) and *L. atrobrunnea* (filled squares).

2. *Ledebouria asperifolia* (Van der Merwe) S. Venter comb. nov., Type: South Africa. Natal, hillsides at Ladysmith, Van der Merwe 2604 (PRE!, holo.; iso. NU!).
Scilla asperifolia Van der Merwe in Fl. Pl. S. Afr. 24: t.944 (1944).

Diagnostic Features:

Purplish-brown dead bulb scales, leaves fully developed at anthesis, leaves and scape covered in tongue-shaped asperities and bracteoles absent.

Discussion:

The only species with which *L. asperifolia* can be confused is *L. revoluta* (L.f) Jessop, but the tongue-shaped asperities on the leaves and scape are however diagnostic.

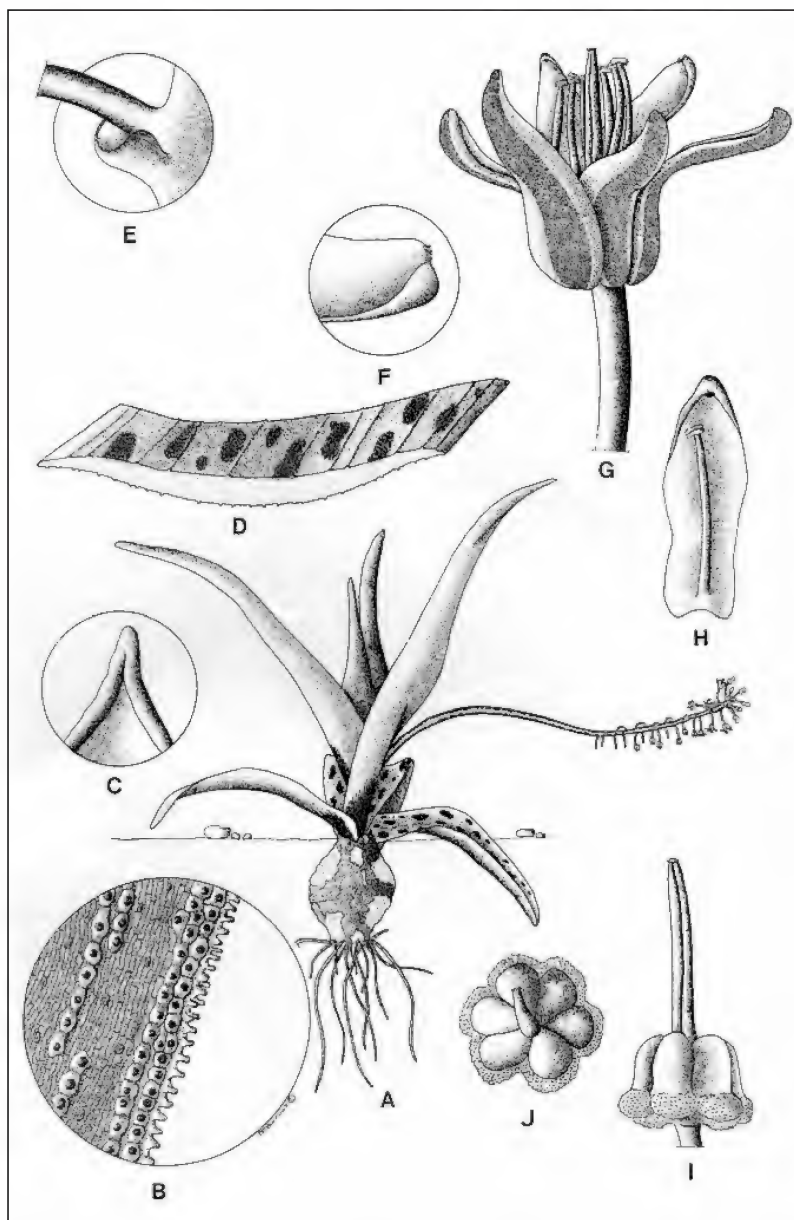
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 4. *Ledebouria asperifolia*. **A**, habit $\times 1$; **B**, lamina margin $\times 300$; **C**, leaf apex $\times 10$; **D**, section through lamina $\times 4$; **E**, bract $\times 10$; **F**, tepal apex $\times 20$; **G**, flower $\times 10$; **H**, tepal with stamen $\times 10$; **I**, ovary lateral view $\times 10$; **J**, ovary distal view $\times 10$. All from Venter 13249.

3. *Ledebouria atrobrunnea* S. Venter. Bothalia 28 (1): 15 (1998).

Type: South Africa – North West Province, Rustenburg, Kroondal, farm Zuurplaat 337. Venter 13460 (PRE!, holo.; NU!; UNIN!, iso.).

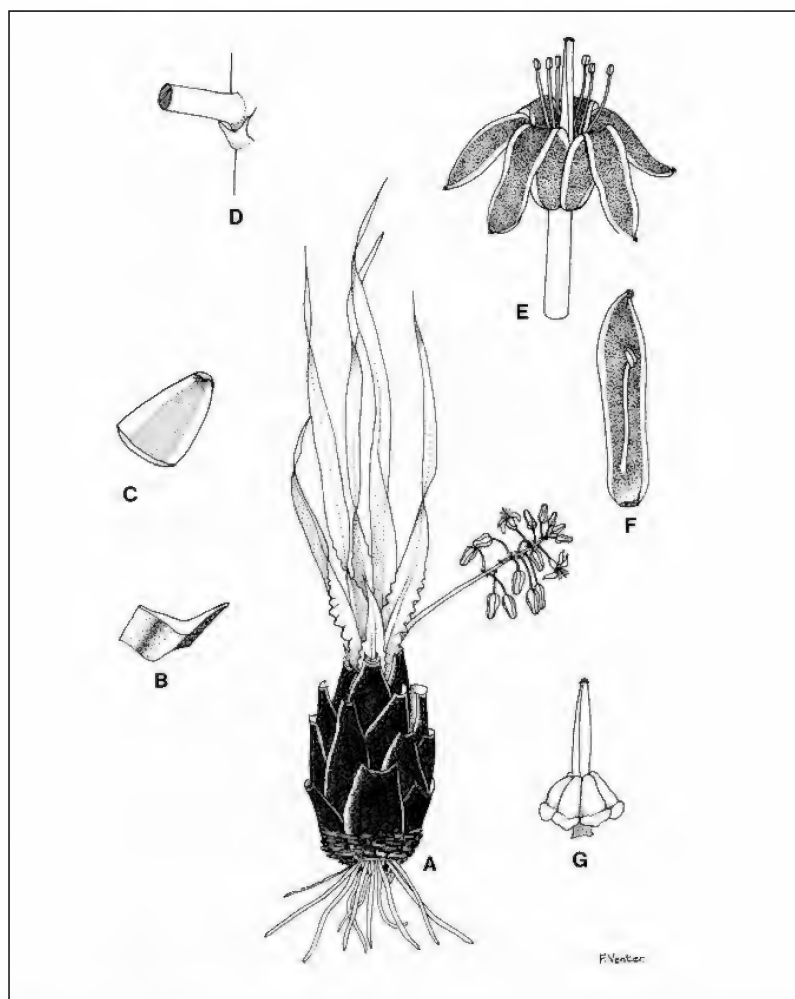


Fig. 5. *Ledebouria atrobrunnea*. A, habit $\times 1$; B, section through lamina $\times 5$; lamina margin $\times 300$; C, tepal apex $\times 20$; D, bract $\times 20$; E, flower $\times 10$; F, tepal with stamen $\times 10$; G, ovary lateral view $\times 10$. Drawn from Venter 13460 and is associated with closed deciduous low woodland.

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA**Diagnostic Features:**

The hard purplish-brown dead bulb scales, erect twisted glaucous leaves that are undulate in the lower half, longitudinally ridged rachis and the presence of apical and basal lobes on the ovary.

Discussion:

Ledebouria atrobrunnea is related to *L. dolomiticola* S. Venter and *L. viscosa* Jessop, which also have cylindrical bulbs with membranous dead bulb scales and erect leaves. *L. atrobrunnea* is distinguished by its linear-lanceolate, non-viscid, twisted leaves and its hard purplish-brown (hence the specific epithet) bulb scales.

4. *Ledebouria concolor* (Baker) Jessop, Journ. S. Afr. Bot. 36(4): 254 (1970).

Type: South Africa - Cap. B. Spei, Cooper s.n. (K!, holo.; PRE!, photo.).

Drimia cooperi Baker in Saund. Ref. Bot. 1: t.18 (1868).

Scilla concolor Baker in Saund. Ref. Bot. 3, Appen.: 13 (1870).

Type: As for *Drimia cooperi*.

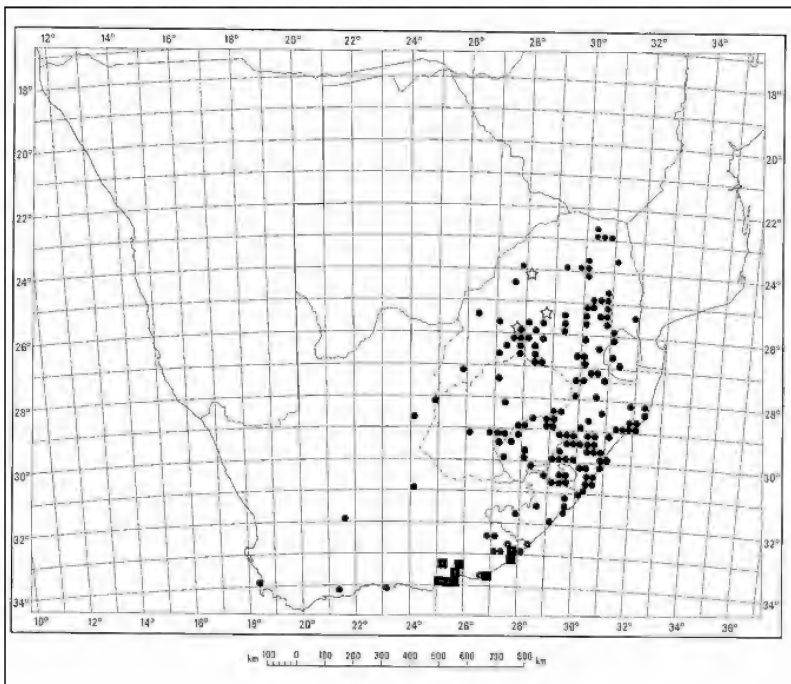


Fig. 6. Known distribution of *L. concolor* (squares), *L. confusa* (stars) and *L. cooperi* (filled circles).

Diagnostic Features:

The semi-epigeal gregarial bulbs with purplish-brown dead bulb scales with prominent transverse ridges, truncate live bulb scale apices, basal stem, concolorous leaves with prominent venation, obtuse lamina apex, smooth rachis and the bracts that are either vestigial or absent.

Discussion:

L. concolor is allied to *L. venteri* Van Jaarsv. & A.E. van Wyk in the gregarious semi-epigeal bulbs and concolorous leaves, but it has different inflorescence morphology.

5. *Ledebouria confusa* S. Venter, sp. nov., Type: South Africa. Franspoort, 25 miles NE of Pretoria. 23.xiii.1934. Mogg 14929 (PRE, holo.!).

Ledebouriae atrobrunneae S.Venter affinis sed ab illa bulbis pro parte epigaeis, squamis brunneis, induratis, horizontaliter cristatis vestitis, foliis in parte ad anthesin emersis, pagina abaxiale infera lineis horizontalibus numerosis ornata tepaliscum apice obuso discedit.

Plants gregarious. *Bulb* semi-epigeal, 60–100 × (40–)70–100 mm, dead bulb scales purplish-brown, hard, apices with horizontal ridges, with threads when torn, live bulb scales purplish-pink inside. *Leaves* partly emerged at anthesis, (5–)6–10, erect-spreading, ovate-lanceolate, 80–150 × (50–)68–90 mm, with threads when torn, dull glaucous, abaxial surface with many horizontal purple lines in lower half; margins white and slightly wavy; apex acute to obtuse and prominently folded closed. *Inflorescences* 1–3, flaccid, longer than the leaves; *peduncle* glabrous, flattened at base, glaucous spotted purple at base, (40–)90–110 mm long; *rachis* longitudinally ridged; raceme 50–130 × (30–)40–50 mm; *bracts* and bracteoles always present, membranous, 0.5–1.0 × 0.25 mm, linear, white. *Pedicels* spreading horizontally, (7–)10–20 mm long, green. *Tepals* strongly recurved, sub equal, oblong, (6–)7–9 × 1.5–2.0 mm, light pink to green, keel green; apex obtuse, thinly cucullate. *Stamens* with filaments 4–5 mm long; olive green at base then bright purple, epitepalous. *Ovary* 1–2 × 2.5–3.0 mm, 6-lobed, lobes narrowly transversely oblong, apex shoulders absent, basal lobes present; stipe 0.25 mm long; *style* 3.8–4.0 mm long, purple with lower ¼ white. *Capsule* globose, base truncate. *Flowering*: Late July to October (Fig. 7).

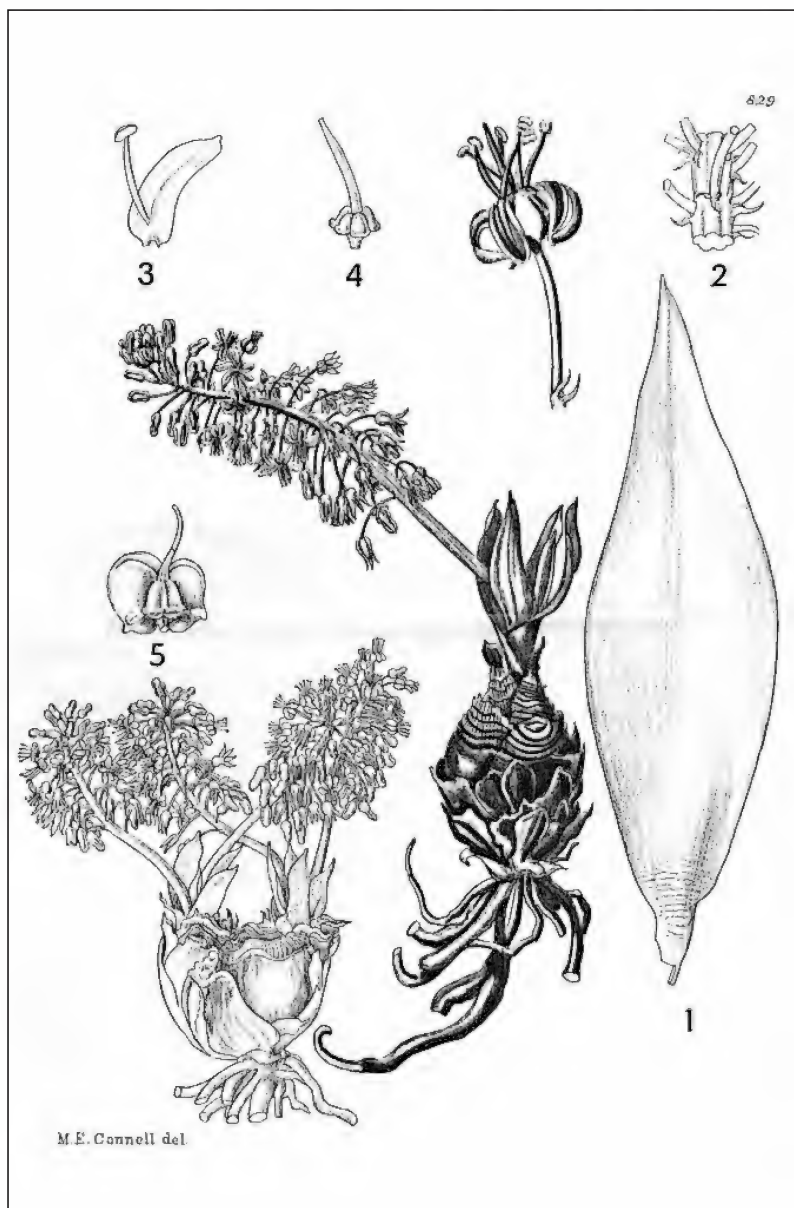
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 7. *Ledebouria confusa*. 1, mature leaf; 2, portion of axis showing bracts; 3, perianth segment with stamen; 4, gynoecium; 5, young capsule with only 2 carpels maturing seeds. (Illustration from FPSA Plate 829 (1941), courtesy of SANBI).

Diagnostic Features:

Semi-epigeal bulbs with hard purplish-brown dead bulb scales with horizontal ridges at the apex, bulb pinkish inside, leaves concolorous, dull glaucous green, partly emerged at anthesis, abaxial surface with many horizontal purple lines in lower half, rachis longitudinally ridged, bracteoles present, tepals strongly recurved and with obtuse apices.

Discussion:

Ledebouria confusa is similar to *L. atrobrunnea* but the plants are gregarial. The dry bulb scales have many thickened horizontal ridges and the leaves are partly emerged at anthesis, also much broader and non-spiral.

6. *Ledebouria cooperi* (Hook.f.) Jessop, Journ. S. Afr. Bot. 36(4):247 (1970).
Scilla cooperi Hook.f., Bot. Mag. 92:t.5580 (1866). Type: **South Africa**.
Cape, *Cooper s.n.* (K!, holo.; PRE!, photo.).
Scilla subglauca Baker, Saund. Ref. Bot. 3:t.186 (1870). Iconotype: Saund.
Ref. Bot.3:t.186, "Cape of Good Hope, Cooper s.n."
Scilla concinna Baker, Saund. Ref. Bot. 4:t.235 (1870). Type: Saund. Ref.
Bot. 4:t.235. "Cape Colony, Cooper s.n."
Scilla exigua Baker, Journ Linn. Soc. (Bot.) 13:247 (1873). Type: **South Africa**. Natal, Camperdown, Farm Assegai Kraal, Sanderson 670 (TCD, holo!).
Scilla barberi Baker, Journ. Linn. Soc. (Bot.) 13:247 (1873). Type: **South Africa**. Transkei, Ad ripas fluminis Tsomo, Barber 805. Type not found.
Scilla saturata Baker, Journ. Bot. 3:365 (1874). Type: **South Africa**. Orange Free State, Cooper 993 (K!, holo.; PRE!, photo.).
Scilla adlamii Baker, Gdnrs' Chron. 9(3):521 (1891). Type: **South Africa**. Natal, Adlam s.n. (K!, holo.; BOL!, drawing; PRE!, photo.).
Scilla fehri Baker, Bot. Jahrb. 15(35):7 (1892). Type: **South Africa**. Transvaal, Pretoria, Fehr s.n. (Z!, holo.).
Scilla inandensis Baker, Flora Cap. 6:483 (1896). Type: **South Africa**. Natal, Inanda, Wood 630 (SAM!, lecto.; BOL!; NH!).
Scilla globosa Baker, Flora Cap. 6:484 (1896). Type: **South Africa**. Natal, Griqualand Orientalis, In humilosis prope Kokstad, Tyson 1557. (SAM!, holo.; BOL!).

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

- Scilla rogersii* Baker, Flora Cap. 6:486 (1896). Type: **South Africa**. Cape Colony, Rogers s.n. (K!, holo.; PRE!, photo.).
- Scilla palustris* Wood & Evans, Journ. Bot. 37:251 (1899). Type: **South Africa**. Natal, in swamp near Newcastle, Wood 6501 (NH!, holo.; PRE!, photo.).
- Scilla rehmannii* Baker, Bull. Herb. Boiss. 2(1):853 (1901). Type: **South Africa**. Natal, Inanda, Rehmann 8277 (Z!, holo.).
- Scilla aggregata* Baker, Bull. Herb. Boiss. ser. 2(4):1001 (1904). Type: **South Africa**. Transvaal, Modderfontein, Conrath 701 (K!, holo.; GRAZ; PRE!, photo.).
- Scilla tristachya* Baker, Bull. Herb. Boiss. ser. 2(4):1001 (1904). Type: **South Africa**. Transvaal, Modderfontein, Conrath 693 (GRAZ, holo.; BOL!, drawing; PRE!, photo.; Z.).
- Scilla conrathii* Baker, Bull. Herb. Boiss. ser. 2(4):1002 (1904). Type: **South Africa**. Transvaal, Modderfontein, Conrath 699 (K!, holo.; GRAZ; PRE!, photo.).
- Scilla londonensis* Baker, Bull. Herb. Boiss. ser. 2(4):1002 (1904). Type: **South Africa**. Cape, East London, Conrath 694 (GRAZ; PRE!, photo.).
- Scilla glaucescens* Van der Merwe, Flower. Pl. S. Afr. 23:t.912 (1943). Type: **South Africa**. Transvaal, Carolina, on farm Onbekend, Van der Merwe 2073 (PRE!, holo.).

Diagnostic Features:

The loosely arranged live bulb scales with no threads when torn, solitary cataphyll, light green lamina margin, smooth rachis, spreading to recurved pink to deep pink tepals (sometimes with a greenish keel), obtuse and strongly cucullate tepal apices, free stamens, raised apices of the ovary shoulders and the seed yellowish-brown to brown.

Variation: A most variable species especially in the shape and coloration of the leaves.

7. *Ledebouria coriacea* S. Venter, sp. nov. Type: **South Africa**. Eastern Cape, Port Elizabeth, 'The Aloes' Railway Station, Venter 13307 (PRE!, holo.; NU!; UNIN!).

HERBERTIA 62 • 2008

Ad *L. cooperi* (Hook.f.) Jessop arcte affinis sed foliis coriaceis marginibus incrassatis; inflorescentia erecta solitaria et ovarii lobis ad apicem conspicue rotundatis prominentibus bene distinguenda.

Plants gregarious. *Bulb* 30-40 × 15-20 mm; dead bulb scales brown, apices attenuate, live bulb scales fleshy, with threads when torn. *Leaves* fully developed at anthesis, 2-9, spreading but mostly appressed, lanceolate, 30-50 × 8-15 mm, with sparse threads when torn, leathery, surfaces dull, green with faint darker green blotches, venation obscure; margins thickened; apex acute. *Inflorescence* solitary, lax, 30-40 × 15-20 mm, erect, longer than the leaves; scape terete at base, glabrous; rachis smooth, 40-50 mm long. *Bracts* fleshy, 0.75 × 0.75 mm, deltoid, green with bracteoles. *Pedicels* cernuous, 5 mm long, speckled pink soon turning green. *Perianth* 5 mm long, tepals recurved, oblong, 5 × 1.5 mm, apex acute, slightly cucullate, green suffused purple. *Stamens* erect, filaments 3 mm long, upper part purple, lower part white, base slightly flattened, epitepalous; anthers 1 mm long, violet. *Ovary* ovoid, 6-lobed, 1.25 × 2 mm, lobes deltate, apex shoulders raised. *Style* 3.2-3.5 mm long, triangular, glabrous, purple; stigma above anthers; stipe 0.5 x 0.5 mm. *Capsule* globose; base truncate. *Seed* drop-shaped, 2 mm long, surface strongly wrinkled, brown. *Flowering*: From October to December (Fig. 8).

Diagnostic Features:

Attenuate bulb scales, leathery leaves with dull surfaces and thickened margins, solitary erect inflorescence with a smooth rachis and fleshy deltoid bracts with bracteoles.

Discussion:

L. coriacea is not closely allied to other *Ledebouria* species.

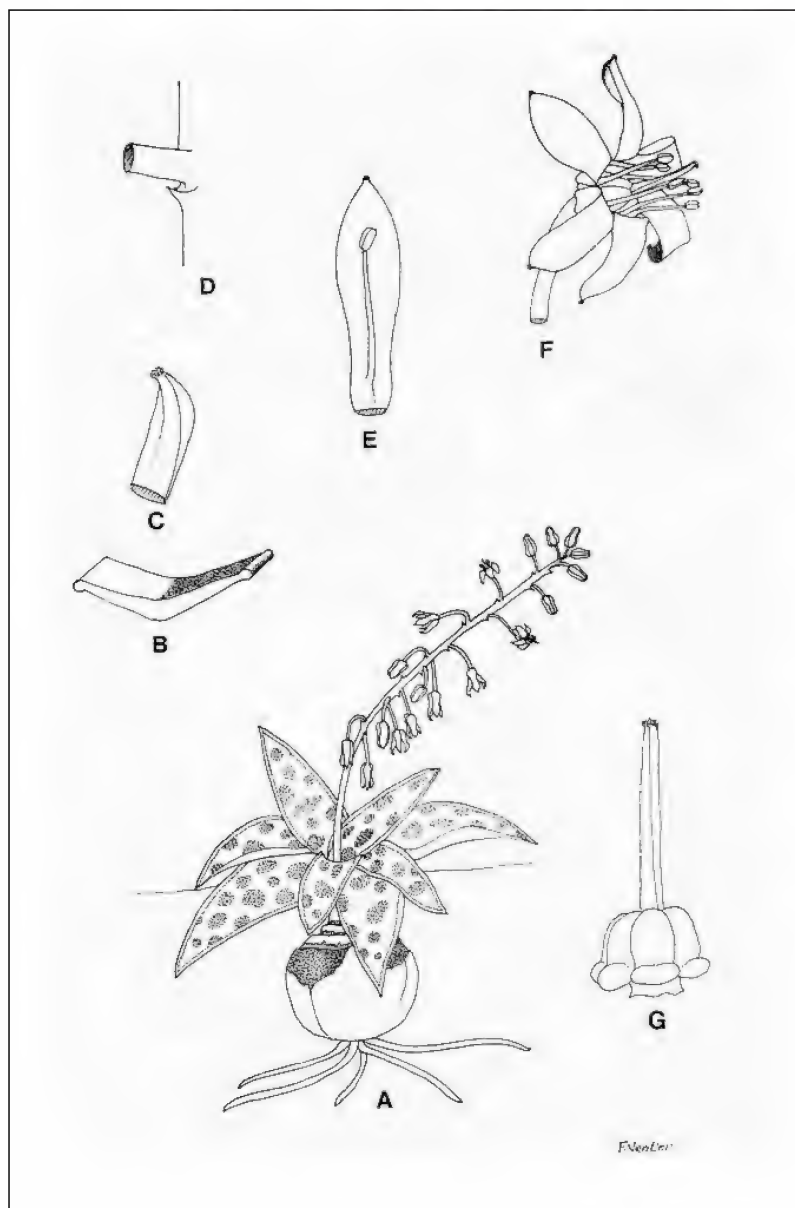
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 8. *Ledebouria coriacea*. **A**, habit $\times 2$; **B**, section through lamina $\times 5$; **C**, lamina margin $\times 300$; **D**, bract $\times 10$; **E**, tepal with stamen $\times 10$; **F**, flower $\times 10$; **G**, gynoecium lateral view $\times 10$. All from Venter **13307**.

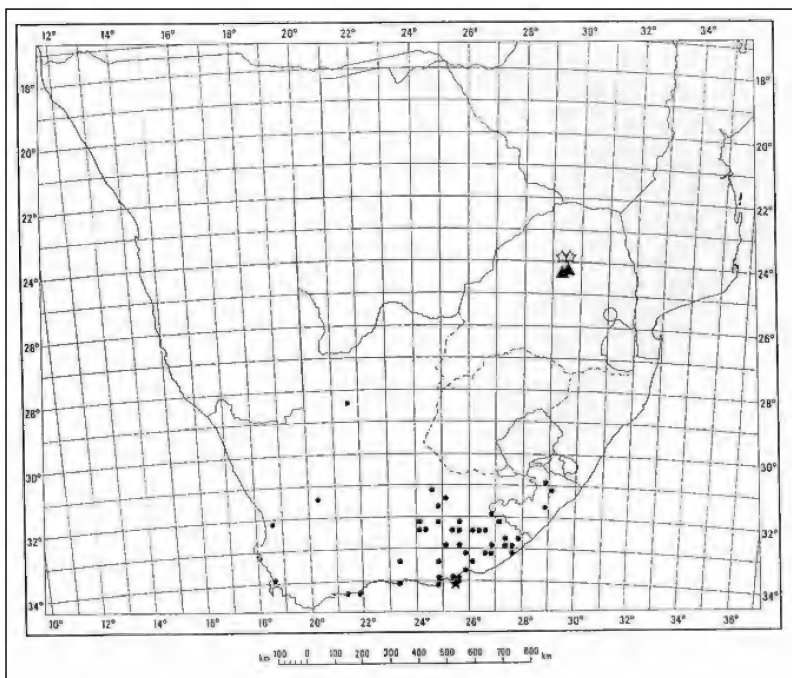


Fig. 9. Known distribution of *L. coriacea* (filled star), *L. crispa* (stars), *L. cremnophila* (circle), *L. dolomiticola* (filled triangles) and *L. ensifolia* (filled circles).

8. *Ledebouria crispa* S. Venter, Bothalia 28(2):179 (1998). Type: South Africa – Northern Province, Pietersburg, Farm Majebes Kraal 1002 LS, Venter 11202 (PRE!, holo.; UN!; UNIN!).

Diagnostic Features:

The semi-epigeal to epigeal bulbs with membranous honey-brown dead bulb scales, prominent neck to the bulb, leaves dull glaucous green with undulate to crispate margins, solitary erect and lax inflorescence, smooth rachis, white membranous bracts with bracteoles, apex of ovary tapering into the style and the black seeds.

Discussion:

L. crispa is closely related to *L. undulata* (Jacq.) Jessop but differs in having the bulb 15-25 mm long whereas with *L. undulata* the bulb can be 30-50 mm long. In *L. crispa* the leaves are present at flowering, the leaf margin

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

always crisped and 2-3(-5) mm wide whereas in *L. undulata* the leaves are absent and the leaf margin is only undulate and 8-20 mm wide and rather firmer in texture.

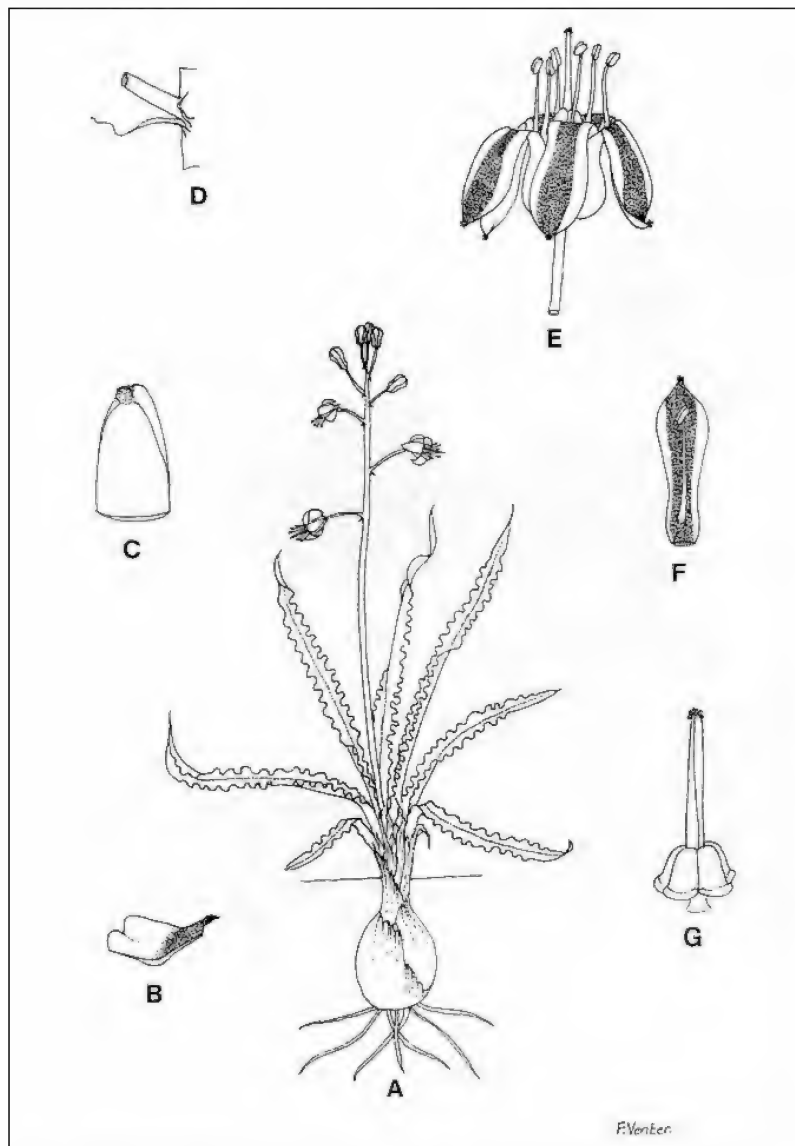


Fig. 10. *Ledebouria crispa*. **A**, habit $\times 1$; **B**, section through lamina $\times 5$; **C**, tepal apex $\times 5$; **D**, bract with bracteole $\times 10$; **E**, flower $\times 10$; **F**, tepal with stamen $\times 10$; **G**, gynoecium lateral view $\times 10$. Drawn from Venter 11202.

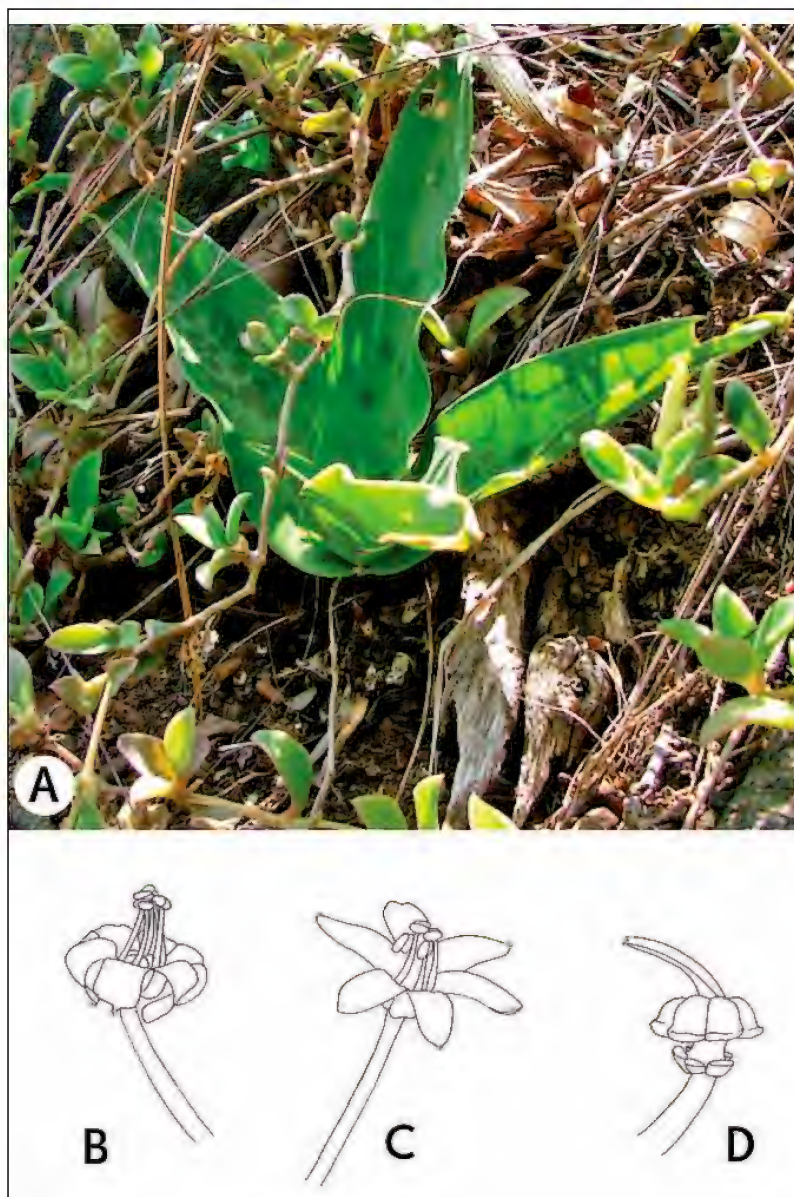


Fig. 11. *Ledebouria cremnophila*. Plant from the type locality (Photo Ernst van Jaarsveld).

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

9. *Ledebouria cremnophila* S. Venter & E.J. van Jaarsv., Aloe 43(4):78-79(2006). Type: **South Africa**. Mpumalanga Province. 2531(Barberton): Farm Crystal Stream 323 JU, on cliff next to Honeybird Creek, (-CA), Venter 13671 (PRE, holo!).

Diagnostic Features:

The bulbs are cylindrical and semi-epigeal to epigeal, dry bulb scales dark brown and the filiform flower bracts form a prominent coma that is very prominent in the young inflorescence.

Discussion:

Ledebouria cremnophila is related to *L. revoluta* but differs in the semi-epigeal to epigeal cylindrical bulbs with dark-brown dry-bulb scales and the filiform flower bracts that form a prominent coma in the young inflorescence.

10. *Ledebouria dolomiticola* S. Venter, Bothalia 28(1):16 (1998). Type: **South Africa**. Limpopo Province, Strydpoort Mountain, Donkerkloof, Farm Rivierplaats 354, Venter 13089a (PRE!, holo.; NU!, UNIN!).

Diagnostic Features:

Characterized by the epigeal cylindrical bulbs, dry bulb scales thinly membranous, bulblets on basal stem, glaucous concolorous erect leaves, solitary lax and flaccid inflorescence, smooth rachis, presence of bracteoles, globose 6-lobed ovary with raised apex shoulders and the globose seed.

Discussion:

L. dolomiticola is closely related to *L. atrobrunnea* and *L. viscosa* Jessop in the cylindrical bulbs, erect leaves (uncommon in *Ledebouria*) and the apex of the ovary forming prominent shoulders. *L. dolomiticola* differs from both in its epigeal bulbs and membranous dead bulb scales.

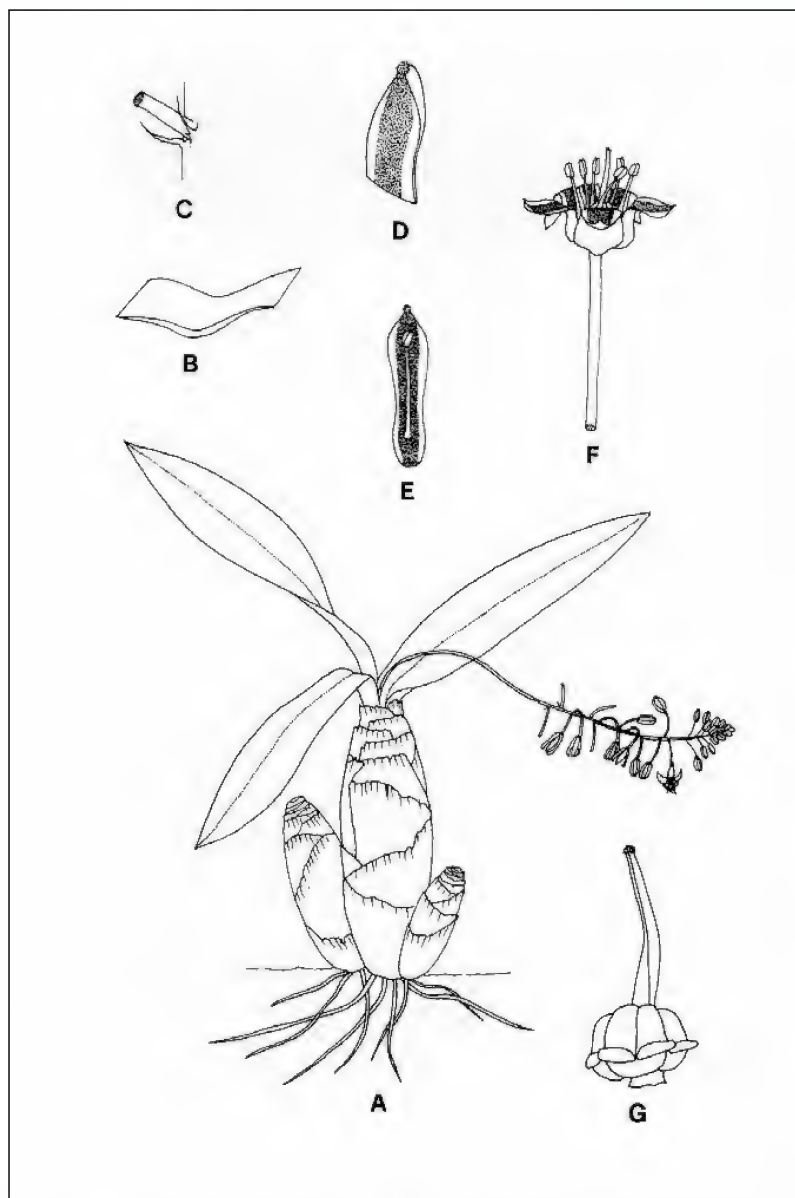


Fig. 12. *Ledebouria dolomiticola*. **A**, habit $\times 0.3$; **B**, section through lamina $\times 1.3$; **C**, bract and bracteole $\times 4$; **D**, tepal apex $\times 6$; **E**, tepal with stamen $\times 4$; **F**, flower $\times 4$; **G**, ovary lateral view $\times 6$. Drawn from Venter 13208a.

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

11. *Ledebouria ensifolia* (Eckl.) S. Venter & T.J. Edwards, Bothalia 33(1):49 (2003). Type: **South Africa**. Cape, Uitenhage District, Zwartkops River. Zeyher 10 (K!, lecto.—selected here; PRE!, photo).
Drimia ensifolia Eckl., S. Afr. Quart. Journ. 1:364 (1830). Type: As for *L. ensifolia*.
Scilla ensifolia (Eckl.) Britten, Journ. Bot. 46:201 (1908). Type: As for *L. ensifolia*.
Drimia ludwigii Miq., Bull. Sc. Phys. Neerl.:39 (1839). Type: **South Africa**. Cape, Cap B. Spei, Ecklon & Zeyher 1064 (U, holo.; GRA!; PRE!).
Idothea ludwigii Kunth, Enum. Pl. 4: 681 (1843). Type: As for *Drimia ludwigii*.
Scilla prasina Baker, Saund. Ref. Bot. 3 (App.):10 (1870). Type: **South Africa**. Cape, Kaffirland, Gill s.n. (K!, holo.; PRE!, photo.).
Scilla ludwigii Baker, Saund. Ref. Bot. 3 (App.):9 (1870). Type: **South Africa**. Cape, Cap B. Spei. Zeyher 4262 (K!, holo.; PRE!).
Scilla pusilla Baker, Journ. Bot., Lond. 5:183 (1876). Type: **South Africa**. Transkei, Bazeia. Bauer 293 (K!, holo.; BOL!, drawing; PRE!, photo.).
Scilla ecklonii Baker, Bot. Jahrb. 15(35):7 (1892). Type: **South Africa**. Cape, Tambukiland, mountains between Silo and Windvogelberg. Ecklon & Zeyher 12 (B!, holo.).

Diagnostic Features:

The combination of cylindrical bulbs, dark-brown dead-bulb scales, glaucous ensiform leaves, small flowers and papillate bases of the ovary lobes.

Discussion:

Ledebouria ensifolia is related to *L. apertiflora* sharing fusiform roots, dark dry-dead bulb scales, acute tepals and the apex of the ovary with prominent shoulders. It differs from *L. apertiflora* in the cylindrical bulbs, ensiform leaves and the inflorescences, which are longer than the leaves.

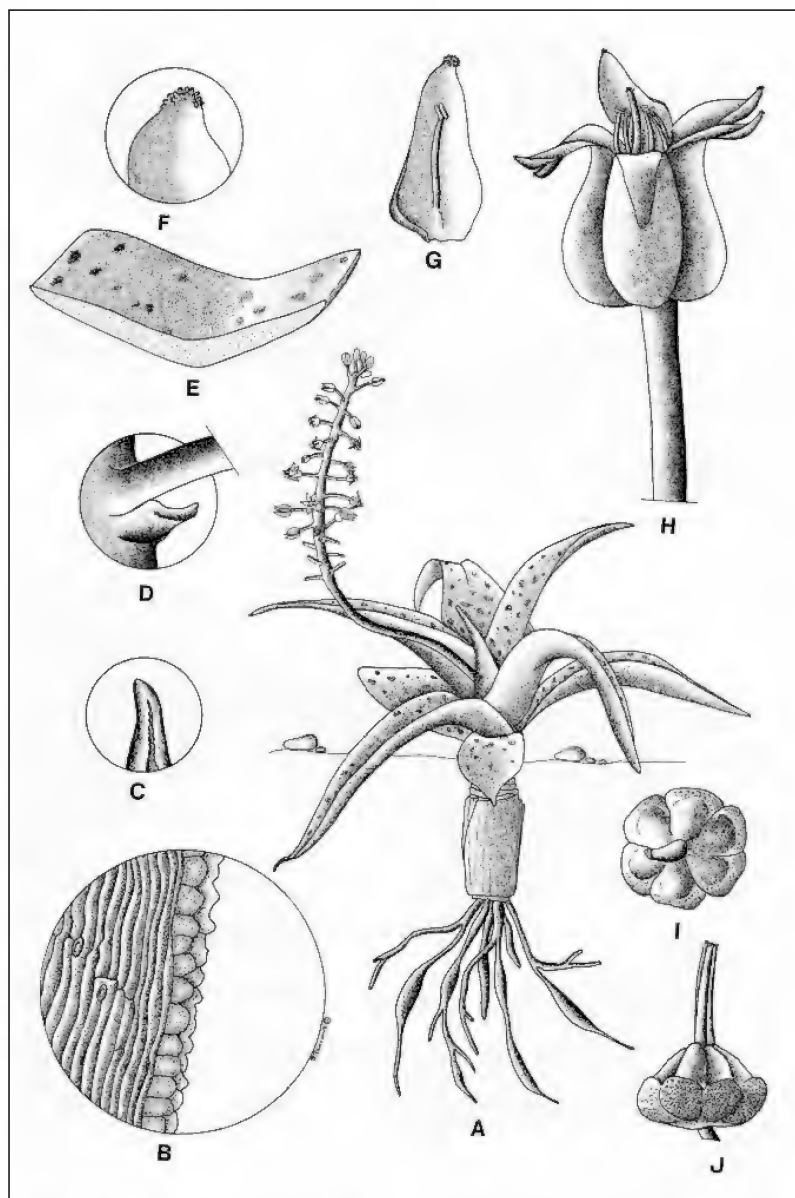


Fig. 13. *Ledebouria ensifolia*. **A**, habit $\times 1$; **B**, lamina margin $\times 300$; **C**, lamina apex $\times 10$; **D**, bract $\times 10$; **E**, section through lamina $\times 5$; **F**, tepal apex $\times 20$; **G**, tepal with stamen $\times 10$; **H**, flower $\times 10$; **I**, ovary dorsal view $\times 10$; **J**, ovary lateral view $\times 10$. Drawn from Smith 155.

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

12. *Ledebouria floribunda* (Baker) J.P. Jessop, Journ. S. Afr. Bot. 36(4):251 (1970). Type: **South Africa**. Cap. b. Spei, Cooper s.n. (K!, holo.; PRE!, photo.).
- Scilla floribunda* Baker, Saund. Ref. Bot. 3:t.188 (1870). Type: Same as for *Ledebouria floribunda*.
- Scilla pendula* Baker, Saund. Ref. Bot. 3 Appendix:14 (1870). Type: **South Africa**. Cape of Good Hope, Burchell s.n. (K!, holo.; BOL!, drawing).
- Scilla princeps* Baker, Saund. Ref. Bot. 3:t.189 (1870). Type: **South Africa**. Cape of Good Hope, Cooper s.n. (K!, holo.; PRE!, photo.).
- Scilla polyantha* Baker, Gardnr's Chron. 9:104 (1878). Type: **South Africa**. Natal, York, Bull s.n. (K!, holo.; PRE!, photo.).
- Scilla tricolor* Baker, Gardnr's Chron. 14:230 (1880). Type: **South Africa**. Cape, Port Elizabeth, Elwes s.n. (K!, painting; BOL!, copy of painting; PRE!, photo. of painting).
- Scilla subsecunda* Baker, Gardnr's Chron. 16:38 (1881). Type: **South Africa**. Cape, Eastern Districts, Bowker 218 (K!, holo.; BOL!, drawing; PRE!, photo.).
- Scilla lauta* N.E. Br., Kew Bull.:299 (1921). Type: **South Africa**. Transvaal, Pietersburg Div., The Downs, Rogers 23990 (K!, holo.; BOL!, drawing; PRE!, photo.).

Diagnostic Features:

Live bulb scales lacking threads when torn, leaves fully developed at anthesis, leaves 200–300 × 40–50 mm, with threads when torn, inflorescences dense, 60–100-flowered, rachis ridged and 150–225 mm long, bracts and bracteoles membranous, pedicels longer than 12 mm, tepal apices obtuse and cucullate, ovary 6-lobed with the apex tapering into the style, basal lobes present and seeds pear-shaped.

Discussion:

L. floribunda can be confused with *L. revoluta* but differs in the bulb scales having threads when torn, tepals 2–4 mm longer, stigma and stamens equal height, ovary widely trullate not narrowly transversely elliptic and the seed 3.0–3.5 mm longer.

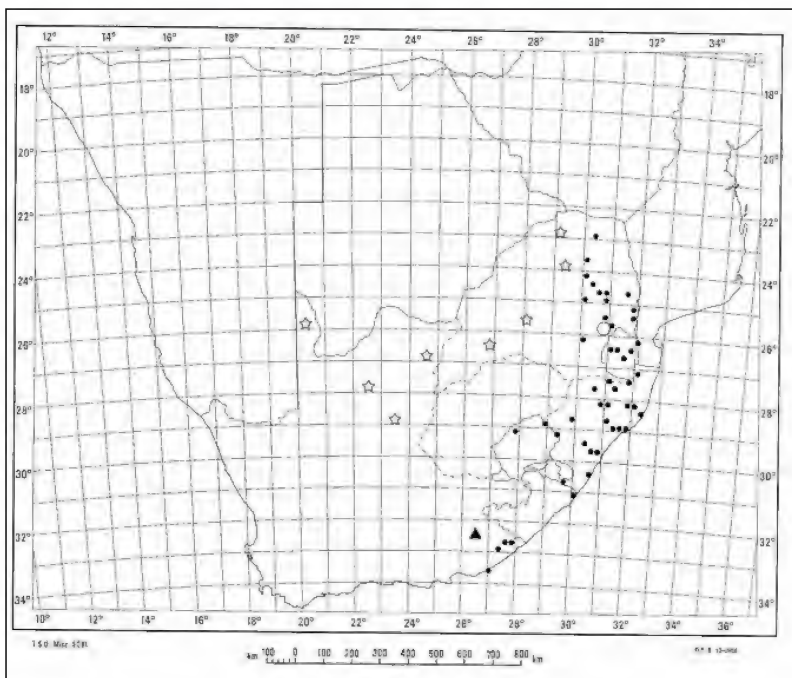


Fig. 14. Known distribution of *L. floribunda* (filled circles), *L. galpinii* (open circle), *L. glauca* (open stars) and *L. hypoxidioides* (filled triangle).

13. *Ledebouria galpinii* (Baker) S. Venter & T.J. Edwards, Bothalia 33(1):50 (2003). Type: **South Africa**. Transvaal, summit of Devil's Kantoor, Galpin 672 (PRE! lecto; BOL!; GRA!; NH!; PRE!, photo.; SAM!; Z). Designated here as lectotype (Greuter et al. 1988).
Scilla galpinii Baker, Flora Cap. 6:487 (1896).

Diagnostic Features:

The humifuse thickly fleshy, glossy purple to purplish-green, leaves with the distinctly lacunose adaxial surface make it a unique species.

Discussion:

This species is closely related to *L. mokobulanensis* Hankey & T.J. Edwards but differs in having humifuse leaves with prominent non-coloured lacunae or pits on the adaxial surface, flaccid inflorescences and a 3-lobed ovary.

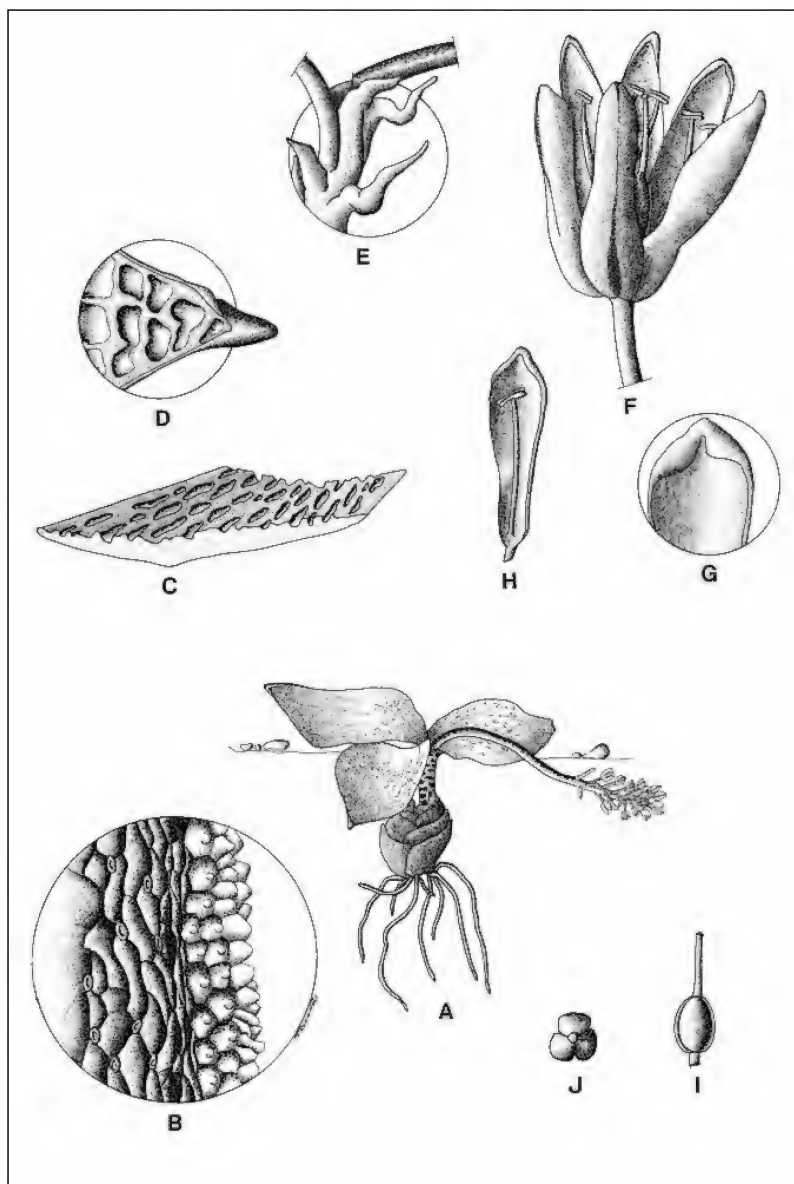
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 15. *Ledebouria galpinii*. **A**, habit $\times 1$; **B**, lamina margin $\times 300$; **C**, section through lamina to show the lacunae $\times 5$; **D**, apex of lamina $\times 20$; **E**, bracts $\times 10$; **F**, flower $\times 10$; **G**, apex of tepal $\times 20$; **H**, tepal with stamen $\times 10$; **I**, ovary lateral view $\times 10$; **J**, ovary distal view $\times 10$. All from Venter 13389.

14. *Ledebouria glauca* S. Venter, sp. nov. Type: South Africa – Limpopo Province, Polokwane (Pietersburg), Fauna Park, Venter 13368 (PRE! holo.; NU!)

Ad *L. cooperi* (Hook.f.) Jessop cognata sed foliis coriaceis, glaucis; inflorescentiis erectis, quam foliis brevioribus; ovario basi lobato manifeste differt.

Bulb 15-70 × 15-30 mm, cylindrical; dead bulb scales light brown, apices truncate, attenuate only at the extreme tips, live bulb scales with threads when torn; neck 3-30 × 3-10 mm; basal stem 5-50 × 10-20 mm. *Leaves* fully developed at anthesis, 2-4, spreading, oblanceolate, 50-100 × 8-18 mm, with threads when torn, leathery, dull, glaucous with purple stripes and blotches, purple cross bars at base of leaf, venation obscure; margins finely papillate; apex acute. *Inflorescences* 1-2, 30-50 × 10-20 mm, erect, shorter than leaves; *scape* terete at base, spotted purple; *rachis* ridged, 20-30 mm long. *Bracts* membranous, 1-2 × 0.5 mm, lanceolate to bifurcate, white to pinkish purple, bracteoles present. *Pedicels* spreading horizontally, 5-8 mm long, pink. *Perianth* 5 mm long, tepals recurved, oblong, 5 × 1.5 mm, apex obtuse, cucullate, green and pink to purple with a green keel. *Stamens* erect, filaments 3-4 mm long, slightly flattened at base, maroon, epitepalous; anthers 1 mm long, yellow. *Ovary* ovoid, 6-lobed, 0.5 × 1 mm, lobes narrowly transversely oblong, distal lobes present. *Style* 3 mm long, triangular, purple; stigma equal height to anthers; stipe 0.25 × 0.25 mm. *Capsule* globose; base truncate. *Seed* drop-shaped, 3-5 mm long, surface strongly wrinkled, brown. *Flowering*: October to December (Fig.16).

Diagnostic Features:

The cylindrical bulb with truncate apices to the dead bulb scales, long basal stem, leaves (2-4) fully developed at anthesis, with threads when torn, leathery, dull glaucous with purple stripes and blotches, purple cross-bars at base of leaf, 1-2 dense and erect inflorescences that are shorter than the leaves, rachis ridged, bracts and bracteoles membranous and the filaments slightly flattened at base.

Discussion:

L. glauca is closely related to *L. inquinata* (C.A. Sm.) Jessop and *L. marginata* (Baker) Jessop but differs in having a basal stem and thickly leathery leaves.

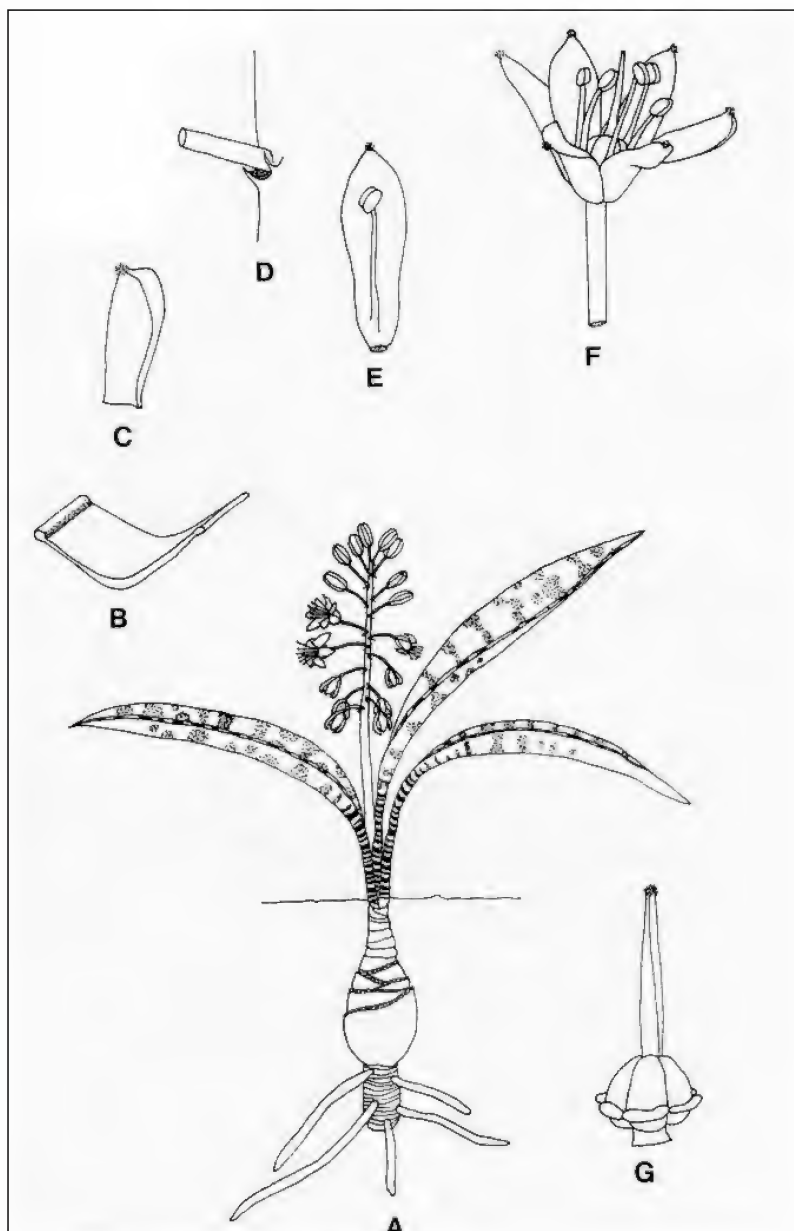
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 16. *Ledebouria glauca*. **A**, habit $\times 1$; **B**, section through lamina $\times 5$; **C**, apex of tepal $\times 20$; **D**, bract with bracteole $\times 10$; **E**, tepal with stamen $\times 10$; **F**, flower $\times 10$; **G**, ovary lateral view $\times 10$. All from Venter 13368.

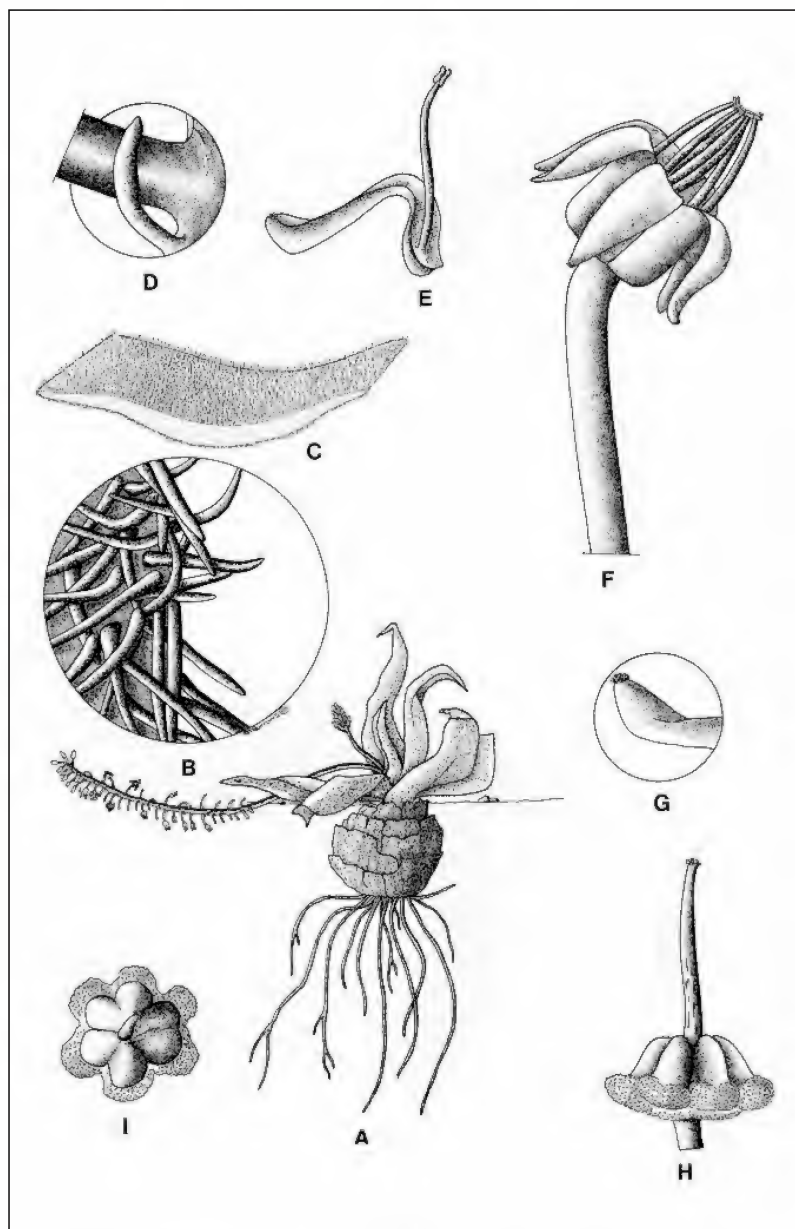


Fig. 17. *Ledebouria hypoxidioides*. **A**, habit $\times 0.25$; **B**, lamina margin $\times 110$; **C**, section through lamina $\times 2$; **D**, bract $\times 10$; **E**, tepal with stamen $\times 10$; **F**, flower $\times 8$; **G**, tepal apex $\times 20$; **H**, ovary lateral view $\times 10$; **I**, ovary distal view $\times 10$. All from Venter 13311.

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

15. *Ledebouria hypoxidioides* (Schönland) J.P. Jessop, Journ. S. Afr. Bot. 36(4):263 (1970). Type: **South Africa**. Cape, Grahamstown, Daly & Sole 435 (GRA!, holo.; BOL!; SAM!; Z!).
Scilla hypoxidioides Schönl., Rec. Albany Mus. 1:48 (1903).

Diagnostic Features:

The densely pilose leaves that are fully developed at anthesis and the red-dish-brown seed.

Discussion:

L. hypoxidioides cannot be confused with any other *Ledebouria* in being the only species with pilose leaves.

16. *Ledebouria inquinata* (C.A. Sm.) J.P. Jessop, Journ. S. Afr. Bot. 36(4):257 (1970). Type: **South Africa**. Transvaal, near Pretoria along Aapies River, Burke s.n. (K!, holo.; PRE!, photo.). Designated here as lectotype (Greuter et al. 1988. Article 7.5).
Scilla inquinata C.A. Smith, Kew Bull. :248 (1930).

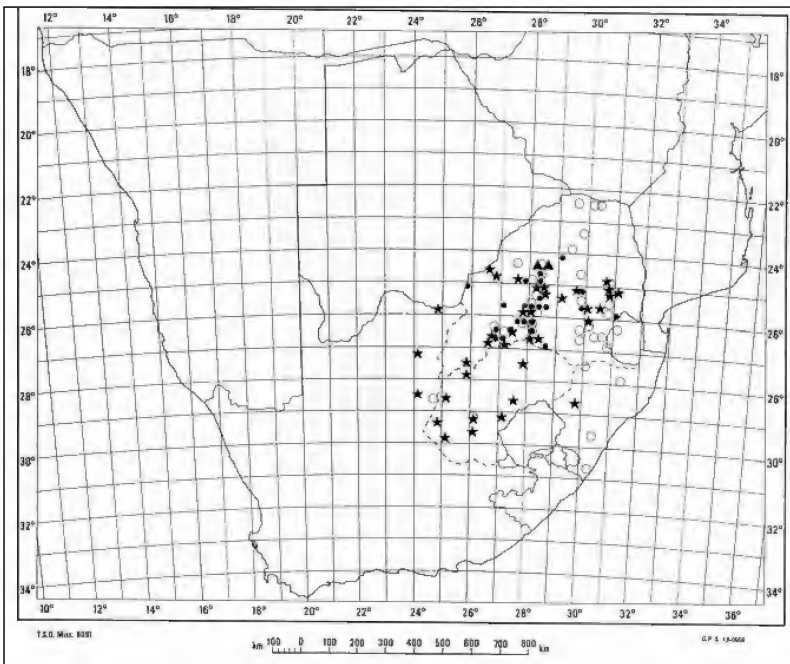


Fig. 18. Known distribution of *L. inquinata* (filled stars), *L. lepida* (filled triangles), *L. leptophylla* (circles) and *L. luteola* (filled circles).

HERBERTIA 62 • 2008

Diagnostic Features:

The apical part of the dead bulb scales are speckled purple, live bulb scales purplish, leaves partly emerged at anthesis, surfaces dull glaucous green with purple markings, margins undulate in lower third of lamina, rachis ridged, bracteoles present, ovary 6-lobed with raised apex shoulders and basal lobes present.

Discussion:

L. inquinata is similar to *L. glauca* and *L. marginata* (Baker) Jessop but is distinguished by the purple spots and blotches on the live bulb scales, leaves undulate at the base and depressed globose ovary. Jessop (1970) apparently failed to see the differences between the type specimens and material he recognized as *L. inquinata* is actually from a plant described here as *L. confusa*.

17. *Ledebouria lepida* (N.E. Br.) S. Venter, comb. nov., Type: South Africa.

Transvaal, Palala River, Breyer s.n., in Herb. Rogers 24009 (K!, holo.; BOL!, drawing; PRE!).

Scilla lepida N.E. Br., Kew Bull.: 299 (1921).

Diagnostic Features:

A distinctive feature of this species is the pilose scape and the small flowers.

Discussion:

Similar to *L. rupestris* but differs in the leaf base marked with purple cross-bars, not petiolate, erect inflorescence and pilose scape.

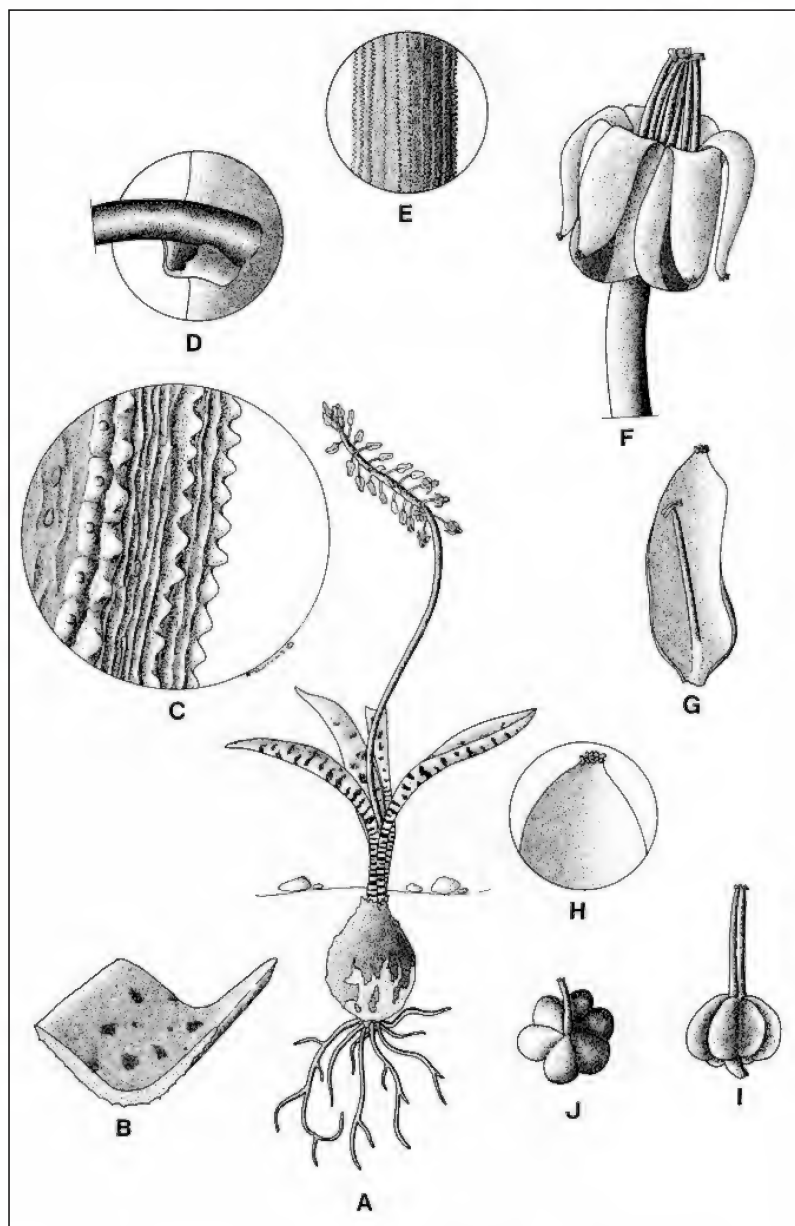
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 19. *Ledebouria lepida*. A, habit $\times 1$; B, lamina margin $\times 300$; C, bract $\times 10$; D, hairs on peduncle $\times 10$; E, section through lamina $\times 2$; F, flower $\times 10$; G, tepal with stamen $\times 10$; H, tepal apex $\times 10$; I, ovary lateral view $\times 10$; J, ovary distal view $\times 10$. All from Venter 13415.

HERBERTIA 62 • 2008

18. *Ledebouria leptophylla* (Baker) S. Venter, comb. nov., Type: **South Africa**. Transvaal, near Devil's Kantoor, Kaapsche Hoop. Bolus 7623 (K !, holo.; BOL !, drawing and iso.).

Scilla leptophylla Baker in Flora Cap. 6:483 (1896).

Scilla graminifolia Baker in Bull. Herb. Boiss. ser. 2(4):1001 (1904). Type: **South Africa**. Transvaal, Modderfontein, Conrath 703 (K!, holo.; BOL!, drawing; GRAZ; PRE!, photo.; Z!).

Scilla stenophylla Van der Merwe in Flower. Pl. S. Afr. 25: t.959 (1944). Type: **South Africa**. Natal, Paulpietersburg, Van der Merwe 2655 (PRE!, holo.).

Ledebouria graminifolia (Baker) Jessop in Journ. S. Afr. Bot. 36(4): 259 (1970). Type: Same as for *S. graminifolia*.

Diagnostic Features:

Live bulb scales without threads when torn, leaves partly emerged at anthesis, linear, with threads when torn, with dull purple spots and cross bars at base, inflorescences longer than the leaves, rachis ridged, bracteoles present, perianth stellate, ovary 6-lobed with the apex shoulders rectangular and the seed black.

Discussion:

L. leptophylla is related to *L. minima* (Baker) S. Venter in having glaucous, linear leaves, stellate flowers and prominent ovary shoulders but differs in the papillate lamina margin, leaves with threads when torn, ridged rachis, prominent bracteole and ovary shoulders.

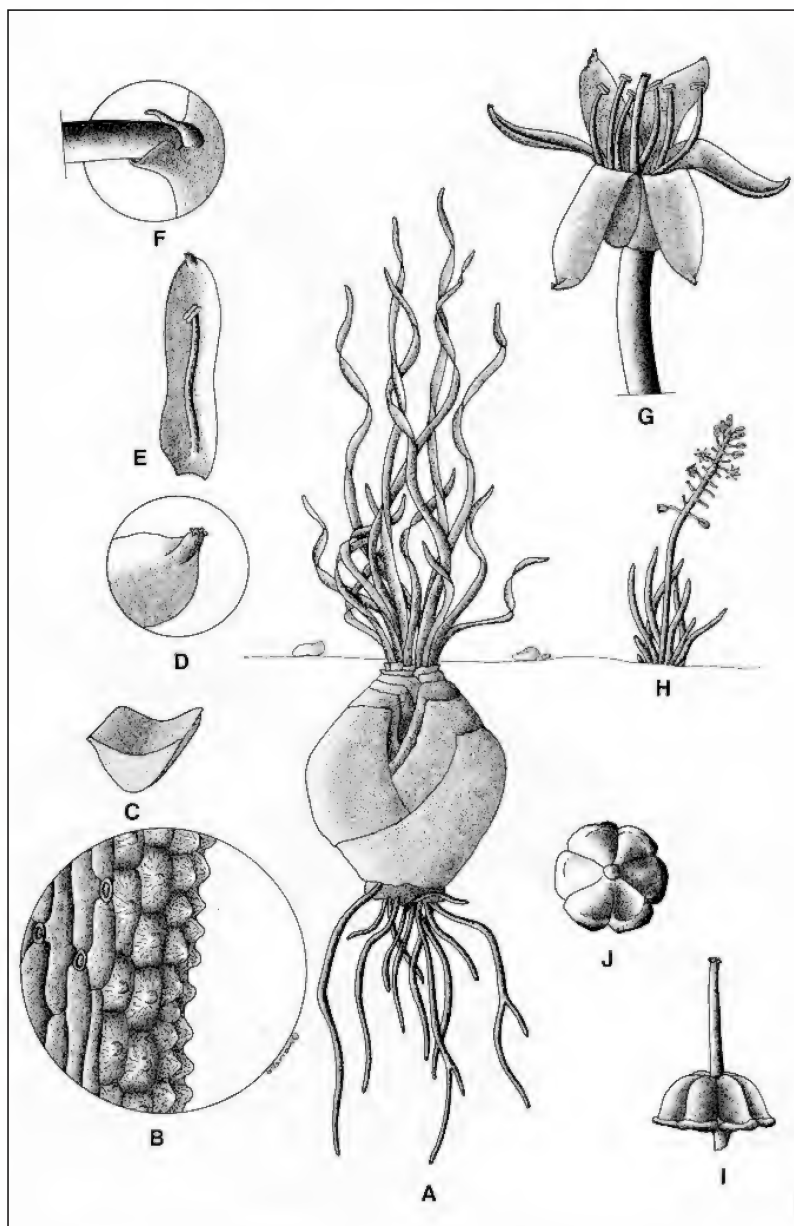
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 20. *Ledebouria leptophylla*. **A**, habit $\times 1$; **B**, lamina margin $\times 300$; **C**, section through lamina $\times 10$; **D**, tepal apex $\times 20$; **E**, tepal with stamen $\times 10$; **F**, bract with bracteole $\times 10$; **G**, flower $\times 10$; **H**, habit of non spiral-leaved form $\times 1$; **I**, ovary lateral view $\times 10$; **J**, ovary distal view $\times 10$. All from Venter 13214, except **H** from Venter 13251.

HERBERTIA 62 • 2008

19. *Ledebouria luteola* Jessop, Journ. S. Afr. Bot. 36(4):260 (1970). Type: South Africa. Transvaal, 6.5 miles south of Hammanskraal, Codd 5625 (PRE!, holo.).

Diagnostic Features:

Live bulb scales with copious threads when torn, leaves fully developed at anthesis, with a dull luster, with copious threads when torn, inflorescences longer than the leaves, rachis ridged, bracteoles present, anthers pale violet, ovary 6-lobed with well-developed basal lobes, capsule globose and the seed brown.

Discussion:

L. luteola is closely related to *L. ovatifolia* (Baker) Jessop but differs in the apices of the bulb scales not at all truncate, leaves spreading and linear-lanceolate to lanceolate.

20. *Ledebouria macowanii* (Baker) S. Venter, Bothalia 28(2):181 (1998).

Scilla macowanii Baker, Gdnr's Chron. 3:748 (1875). Type: South Africa. Cape, Somerset Division, Boschberg, MacOwan 1841 (GRA!, lecto.; BOL!; PRE!, photo.; Z). Here designated as lectotype (Greuter et al 1988).

Scilla nelsonii Baker, Flora Cap. 6:488 (1896). Type: South Africa. Cape, Vaal River, Nelson 167 (K!, holo.; PRE!).

Diagnostic Features:

Live bulb scales without threads when torn, leaves fully developed at anthesis and without threads when torn, 1 – 2 lax inflorescences with smooth rachises, bracts fleshy and without bracteoles, flowers stellate with slightly recurved tepal apices, stamens spreading, anthers pale violet, ovary 6-lobed with apex shoulders raised.

Discussion:

Ledebouria macowanii is closely related to *L. socialis* (Baker) Jessop but the bulbs are hypogaeal not epigeal.

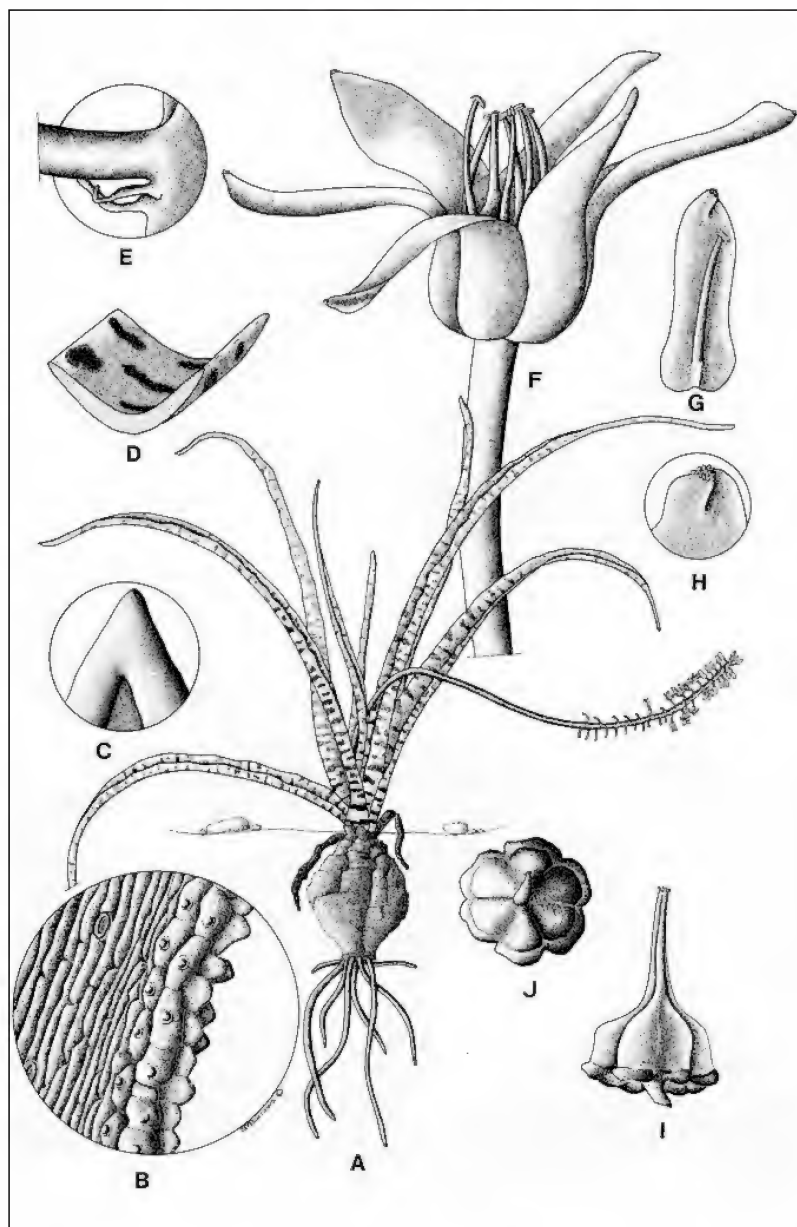
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 21. *Ledebouria macowanii*. **A**, habit $\times 1$; **B**, lamina margin $\times 300$; **C**, section through lamina $\times 2.5$; **D**, bract $\times 10$; **E**, apex of tepal $\times 10$; **F**, flower $\times 5$; **G**, tepal with stamen $\times 10$; **H**, ovary lateral view $\times 10$; **I**, ovary dorsal view $\times 10$. All from Venter 13413.

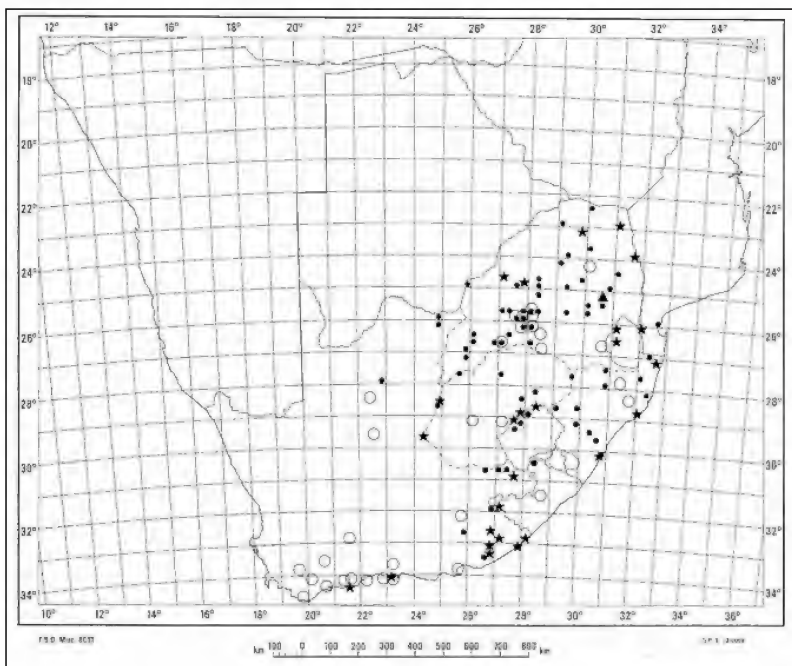


Fig. 22. Known distribution of *L. macowanii* (filled star), *L. marginata* (filled circle), *L. minima* (open circles) and *L. mokobulanensis* (filled triangle).

21. *Ledebouria marginata* (Baker) Jessop, Journ. S. Afr. Bot. 36(4):260 (1970).

Scilla marginata Baker, Bull. Herb. Boiss. ser. 2(4):1002 (1904). Type:
South Africa. Transvaal, Modderfontein, Conrath 703b (GRAZ!;
PRE!, photo.; Z.).

Scilla neglecta Van der Merwe, Flower. Pl. S. Afr. 22:t.865 (1942). Type:
South Africa. Transvaal, Pretoria, Colbyn, Van der Merwe 2441
(PRE!, holo.).

Diagnostic Features:

Leaves partly emerged at anthesis, leaves spirally twisted, venation prominent, with thick bundles of thread when torn making it nearly impossible to break even when dry, bracts with bracteoles and the seeds yellowish-brown.

Discussion:

L. marginata is closely related to *L. inquinata* and *L. glauca* but is easily distinguished by the tough glaucous leaves and many inflorescences.

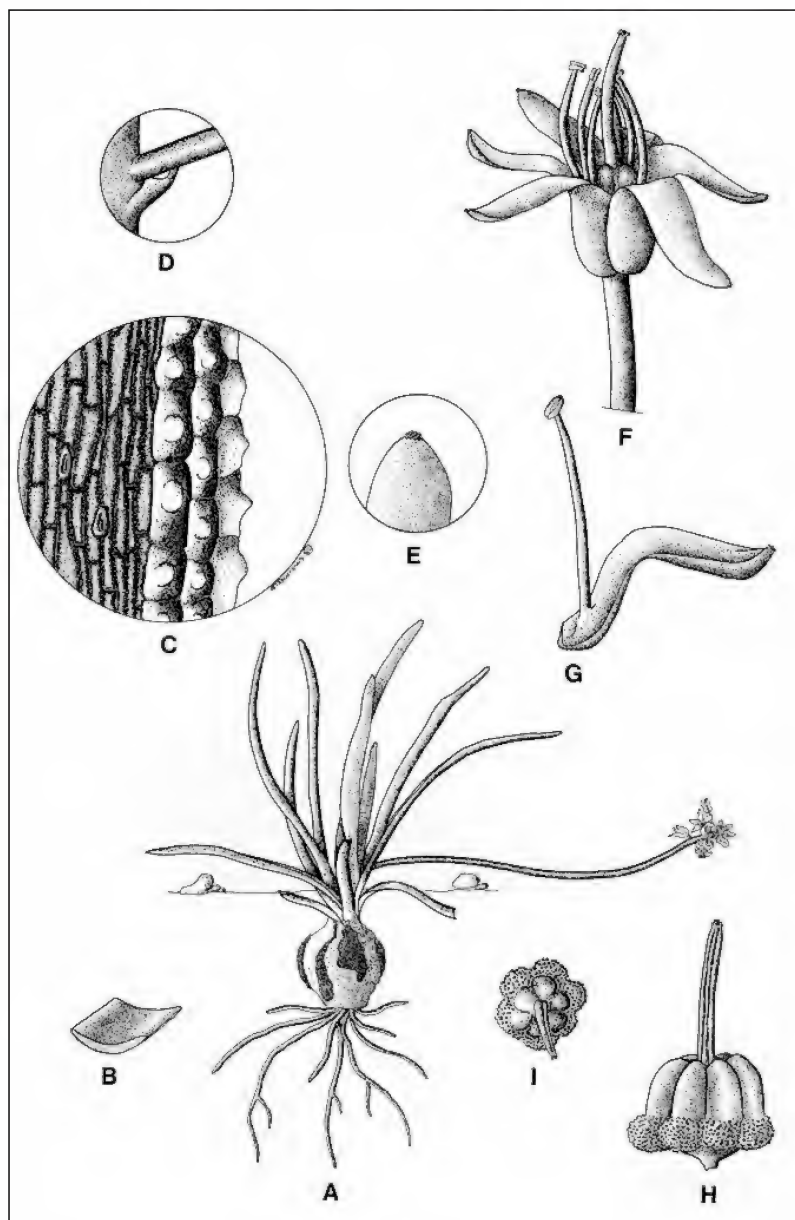
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 23. *Ledebouria minima*. **A**, habit $\times 1$; **B**, section through lamina $\times 5$; **C**, lamina margin $\times 300$; **D**, bract $\times 10$; **E**, tepal apex $\times 20$; **F**, flower $\times 10$; **G**, tepal with stamen $\times 10$; **H**, ovary lateral view $\times 10$; **I**, ovary distal view $\times 10$. All from Venter 13404.

HERBERTIA 62 • 2008

22. *Ledebouria minima* (Baker) S. Venter, comb. nov. Type: South Africa.

Transvaal, on Macalisberg, Burke s.n. (K!, holo.; BOL!, drawing; PRE!, photo.).

Scilla minima Baker, Saund. Ref. Bot. 3(App.):6 (1870).

Diagnostic Features:

Linear leaves $24-36 \times 2-3$ mm with purplish cross bars at the base, inflorescence longer than the leaves. Smooth rachis, fleshy dentate bracts, stellate perianth and the base of the ovary lobes papillate.

Discussion:

Ledebouria minima is closely allied to *L. rupestris* (Van der Merwe) S. Venter. It differs in the glabrous, linear leaves and absence of bracteoles.

23. *Ledebouria mokobulanensis* Hankey & T.J. Edwards, S. Afr. Journ. Bot.

74:214-217 (2008). Type: South Africa. Mpumalanga. Farm Zomerplaat 207 JT, Mokobulaan Plantations. Hankey & Mutshinyalo 1151 (PRE, holo.).

Diagnostic Features:

L. mokobulanensis can easily be distinguished from all other members of the genus by its conspicuously red-pitted upper leaf surface.

Discussion:

L. mokobulanensis can be distinguished from *L. galpinii* the only other *Ledebouria* species which produces leaves with a pitted upper surface, in having smaller, solitary (rarely 2), dull green, cordate leaves with red pits adaxially, as well as a solitary, erect inflorescence.

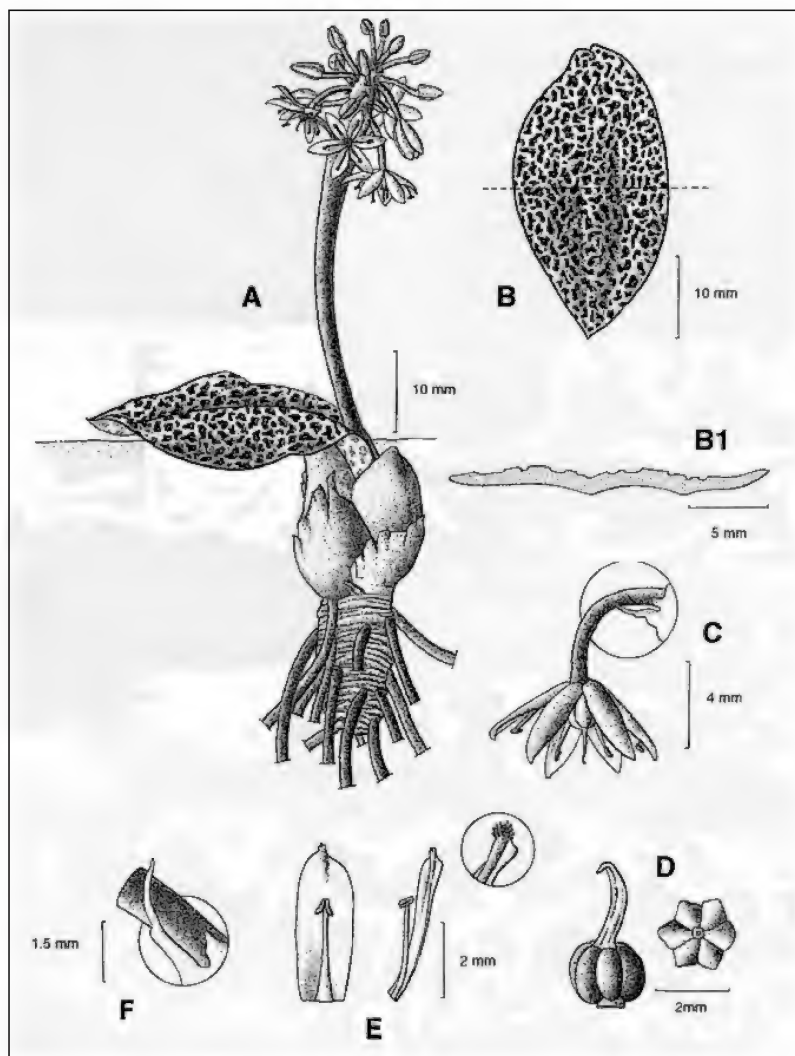
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 24. *Ledebouria mokobulanensis*. **A**, flowering plant; **B**, adaxial leaf surface; **B1**, transverse section of leaf; **C**, single flower; **D**, ovary in dorsal and lateral view; **E**, tepal and anther details (inset: tepal apex); **F**, bract and bracteoles. All from Hankey & Phungula 2067 (courtesy of South African Journal of Botany).

HERBERTIA 62 • 2008

24. *Ledebouria monophylla* S. Venter, sp. nov., Type: South Africa.

Mpumalanga, Graskop, Paradise Camp, Venter 13235 (PRE!, holo.; NU!; UNIN!).

Ad *L. cooperi* (Hook.f.) Jessop sed folio singulo, late ovato, adpresso; inflorescentia solitaria, erecta, pedunculo basi compresso et floribus stellaribus, lobis cucullatis distinctissima.

Bulbs 10–20 × 8–12 mm; dead bulb scales light brown, apices truncate, live bulb scales with threads when torn. *Leaf* 1(–2), sometimes partly emerged but usually fully developed at anthesis, appressed to ground, broadly ovate, 30–40 × 30–40 mm, without threads when torn, thickly fleshy to succulent, glossy green, immaculate, venation obscure; margin smooth, red; apex obtuse to acute. *Inflorescence* solitary, erect, globose, 10–15 × 15 mm, longer than the leaves; *scape* basally compressed, green spotted purple; *rachis* ridged, 10–30 mm long. *Bracts* fleshy, lanceolate to bifurcate, pink, with bracteoles. *Pedicels* spreading, 3–5 mm long, pink. *Perianth* 4 mm long, stellate, tepals oblong, 3.8–4.0 × 1.5 mm, apex obtuse, cucullate, pink to purple. *Stamens* spreading, filaments 1.5–4.0 mm long, base slightly flattened, upper part purple with lower part white, free; anthers 0.5 mm long, yellow. *Ovary* globose, 3-lobed, 1 × 2 mm, lobes depressed ovate, shoulders raised, stipe 0.25 × 0.25 mm. *Style* 1.5 mm long, triangular, purple; stigma above anthers. *Capsule* globose; base truncate. *Seed* drop-shaped, 1.5 mm long, surface strongly wrinkled, brown. *Flowering*: September to December with a peak from September to October (Fig. 25).

Diagnostic Features:

Characterized by the solitary, appressed fleshy leaf without markings or lines, the solitary inflorescence with depressed peduncle, globose raceme, stellate flowers and 3-lobed ovary.

Discussion:

L. monophylla is closely allied to the undescribed taxon discussed by Craib in *Herbertia* 60: 83 (2005–6).

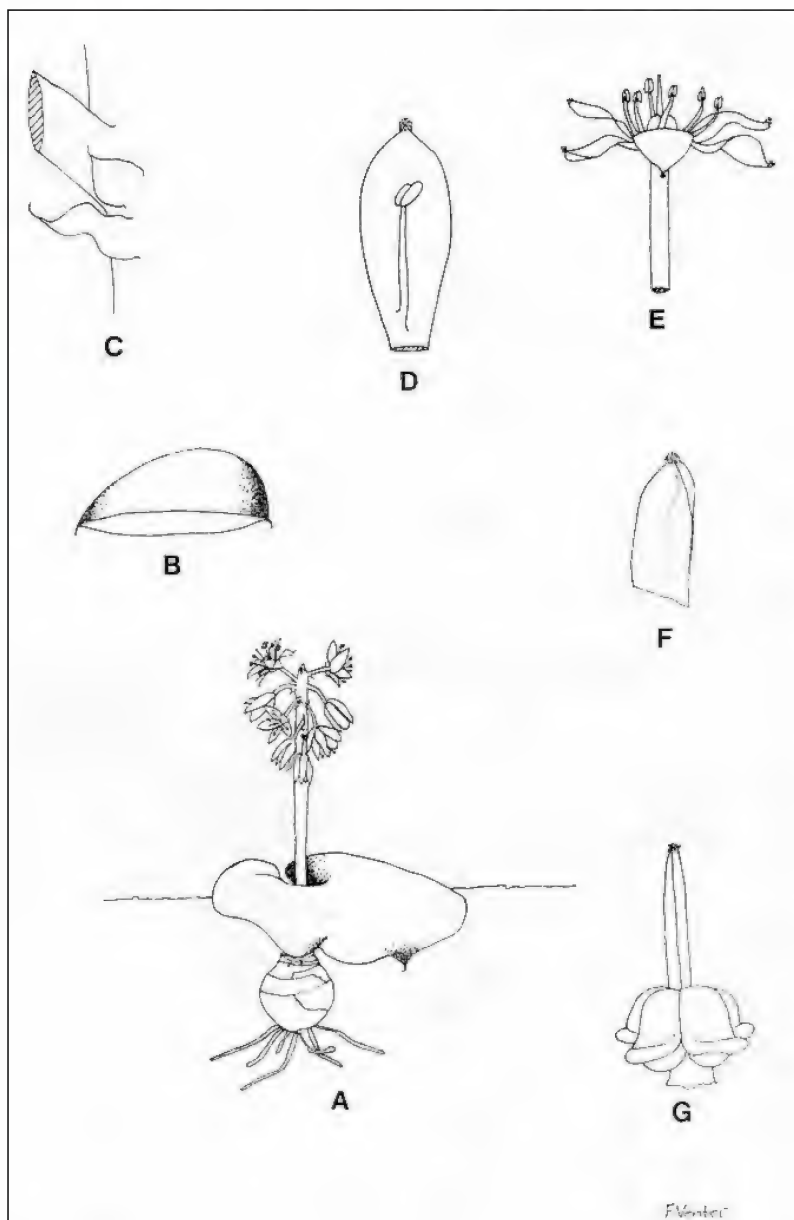
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 25. *Ledebouria monophylla*. **A**, habit $\times 1$; **B**, section through lamina $\times 5$; **C**, bract with bracteole $\times 10$; **D**, tepal with stamen $\times 10$; **E**, flower $\times 10$; **F**, apex of tepal $\times 20$; **G**, gynoecium lateral view $\times 10$. All from Venter 13235.

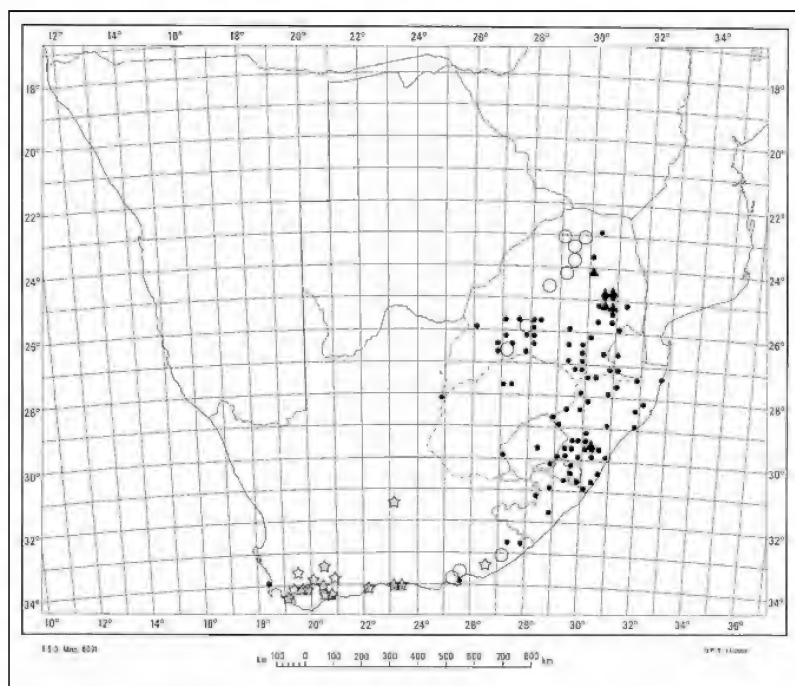


Fig. 26. Known distribution of *L. monophylla* (filled triangle), *L. ovalifolia* (open stars), *L. ovatifolia* (filled circles) and *L. papillata* (open circle).

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

25. *Ledebouria ovalifolia* (Schrad.) Jessop, Journ. S. Afr. Bot. 36(4):246 (1970).
Drimia ovalifolia Schrad., Blumenb.: 28 (1827). Iconotype: Lodd. Bot. Cab. 3: t.278, sub *Drimia lanceaefolia* (1818).
Lachenalia reflexa Andr., Bot. Rep. 5:t.299 (1803), nom. illegit., non Thunb.
Drimia lanceolata Schrad., Blumenb.: 28 (1827). Iconotype: Andr. Bot. Rep. 5:t.299, sub *Lachenalia reflexa* Andr.(1803).
Drimia gawleri Schrad., Blumenb.:30 (1827). Iconotype: In (1811)
 Curtis's Bot. Mag. 33:t1380, sub *Drimia lanceaefolia*, (1811).
Scilla lanceolata (Schrad.) Baker, Saund. Ref. Bot. 3(Append.):14 (1870).
 nom.illegit., non Viviani (1830).
Scilla revoluta (L.f.) Baker, sensu Baker in Flora Cap. 6:485 (1896).
Scilla ovalifolia (Schrad.) C.A. Sm., Kew Bull.:245 (1930). Iconotype:
 Andrews Bot. Rep. 5:t.229 (1803).
Scilla doratophylla C.A. Sm., Kew Bull.:245 (1930). Type: As for *Drimia lanceolata* Schrad.
Scilla genadendalensis Von Poelln.,Port. Acta biol., ser.B, 1:212 (1945).
 Type: **South Africa**. Cape, Genadendal, Schlechter 10327 (PRE!, lecto.; BOL; L; Z!). The PRE specimen designated here as lecto type (Greuter et al 1988).

Diagnostic Features:

Live bulb scales without threads when torn, leaves partly emerged at anthesis and appressed to the ground but sometimes slightly spreading, without threads when torn, with short rows of papillae on the adaxial lamina surface, apices obtuse, inflorescence solitary and lax, rachis smooth, bracts semi-fleshy, without bracteoles, base of filament slightly swollen, anthers violet, ovary 3-lobed, apex shoulders raised.

Discussion:

L. ovalifolia resembles *L. remifolia* S. Venter but differs in the leaves partly emerged at anthesis, petiole not as well formed, solitary inflorescence, rachis smooth, no bracteoles and obtuse tepal apices.

26. *Ledebouria ovatifolia* (Baker) Jessop, Journ. S. Afr. Bot. 36(4):262 (1970).
Scilla ovatifolia Baker, Saund. Ref. Bot. 3:t.183 (1870). Type: **South Africa**. Natal, Cooper s.n. (K!, holo.; PRE!, photo.).
Scilla lanceaefolia (Jacq.) Baker var. *ovatifolia* Baker, Journ. Linn. Soc. 11(54):252 (1870). Iconotype: Saund. Ref. Bot. 3:t.183. "Cap. B. Spei, Cooper s.n.". *Scilla lanceaefolia* sensu Wood & Evans, Natal Plants 3(4):t.202 (1900), non *Lachenalia lanceaefolia* Jacq.
Scilla guttata C.A. Sm., Kew Bull.:243 (1930). Type: **South Africa**. Natal, Durban Div., Cooper s.n. (K!, holo.).
Scilla cicatricosa C.A. Sm., Kew Bull.:246 (1930). Nom. nov. only.
Scilla climacocarpha C.A. Sm., Kew Bull.:249 (1930). Type: **South Africa**. Orange Free State, Bethlehem, Phillips 3068 (PRE!, holo.).
Scilla albomarginata Van der Merwe, Flower. Pl. S. Afr. 24:t.947 (1944). Type: **South Africa**. Natal, Umzinto, Van der Merwe 2669 (PRE!, holo.).
Scilla elevans Van der Merwe, Flower. Pl. S. Afr. 24:t.948 (1944). Type: **South Africa**. Natal, Vryheid, Van der Merwe 2677 (PRE!, holo.).
Scilla collina Hutch., Bot. in S. Afr.:344 (1946). Type: **South Africa**. Transvaal, Soutpansberg, Klein Australe, Smuts & Gillett 4186 (K!, holo.; PRE!, photo.).

Diagnostic Features:

The brown to purple bulb scales with copious threads when torn, appressed leaves with threads when torn, flaccid inflorescences that are longer than the leaves, basally compressed scape and the ridged rachis.

Discussion:

L. ovatifolia is closely related to *L. luteola* but differs in the truncate apices of the bulb scales and the partly emerged, ovate to deltate, mostly humifuse leaves.

27. *Ledebouria papillata* S. Venter, sp.nov., Type: **South Africa**. Limpopo Province, Polokwane (Pietersburg), Venter 13186 (PRE!, holo.; NU!; UNIN!).

Ad *L. cooperi* (Hook.f.) Jessop affinis sed squamis ad apicem truncatis; petiolo purpureo fasciato; inflorescentiis erectis, pedunculo pappilato; ovario stipitato, stipite 0.5 mm longo; ovario dorsaliter lobato differt.

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

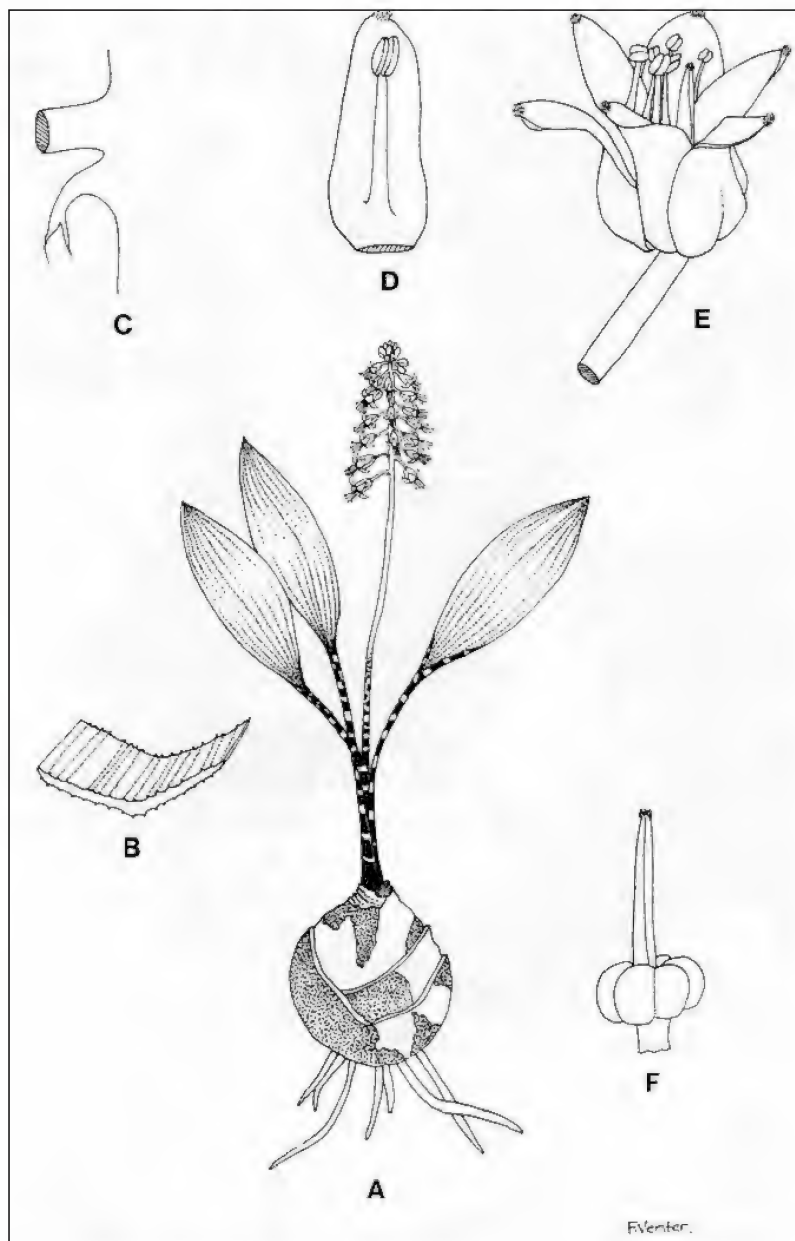


Fig. 27. *Ledebouria papillata*. **A**, habit $\times 1$; **B**, section through leaf $\times 3$; **C**, bract $\times 10$; **D**, tepal with stamen $\times 10$; **E**, flower $\times 10$; **F**, gynoecium lateral view $\times 10$. All from Venter 13008.

Bulb 15-30 × 8-20 mm; dead bulb scales light brown, membranous, apices truncate, live bulb scales without threads when torn, neck 3-27 × 3-7 mm; basal stem 5-15 mm long. *Cataphylls* 2, reaching ground level. *Leaves* fully developed at anthesis, spreading, linear-lanceolate to oblanceolate, 30-90 × 4-10 mm, with few threads when torn, adaxial surface glossy dark green, abaxial surface dull purplish green with rows of longitudinal papillae, prominent dark purple cross bars at base, venation prominent; margins papillate; leaf base petiolate, canaliculate; apex acute to acuminate. *Inflorescences* 1-2, 20-60 × 10-20 mm, erect, longer than the leaves; *scape* terete at base, spotted and striped purple, longitudinally papillate, *rachis* ridged, 50-120 mm long. *Bracts* fleshy, 0.5 × 0.25 mm, oblong to bifurcate, pink, white or green without bracteoles. *Pedicels* spreading horizontally, 2.5-5.0 mm long, pink. *Perianth* 2.0-3.5 mm long, tepals reflexed, oblong, 3.0-3.5 × 1.0-1.5 mm, apex obtuse, thinly cucullate, pink to purple with a green keel. *Stamens* erect, filaments 3 mm long, maroon, epitepalous; anthers 0.5 mm long, violet. *Ovary* globose, 6-lobed, 1.5 × 2.5 mm, lobes depressed ovate, apex shoulders raised, distal lobes present. *Style* 3.5 mm long, purple; stigma equal height to anthers; stipe 0.5 × 0.5 mm. *Capsule* globose; base tapering. *Seed* globose, 2 mm long, surface strongly wrinkled, brown. *Flowering*: October to January with a peak in November (Fig. 27).

Diagnostic Features:

Prominent neck to the bulb, leaves 2-4 and fully developed at anthesis, 2 cataphylls reaching ground level, leaves glossy dark green, abaxial surface dull purplish green with rows of longitudinal papillae, base of lamina nearly petiolate with prominent dark purple cross-bars at base, venation prominent, 1-2 erect dense inflorescences, scape terete at base, green, spotted and striped purple, longitudinally papillate, rachis ridged, bracteoles absent, perianth small, 2.0-3.5 mm long with violet anthers.

Discussion:

L. papillata is closely related to *L. galpinii* but differs in having longitudinal rows of papillae on the adaxial leaf surface, purple cross bars on the petiole, erect inflorescences, and papillate peduncles.

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA**28. *Ledebouria pardalota* S. Venter, sp. nov., Type: South Africa.**

Mpumalanga Province, Barberton area, Angle Station track. 03.xi.2007.

Lötter & Turpin 1315 (PRE, holo!).

L. revolutae affinis sed collo bulbis prominente exhibente, foliis distractis fibras carentibus, inflorescentias 1, (rarius 2) producente, bracteolas carente, filamentos 5 mm longis et ovario dorsaliter lobato satis differt.

Bulbs (26-) 33-80 × (25-)30-54 mm; dead bulb scales dark brown, membranous, apices attenuate, live bulb scales without threads when torn, purplish inside; neck prominent, 20-30 × 12-17 mm. *Leaves* fully developed at anthesis, 3-5, spreading, lanceolate to oblong, 68-150 × (26-)36-45 mm, without threads when torn; adaxial surface pea green with prominent pruinose blotches and spots, venation obscure; margin smooth and revolute; abaxial surface prominently pruinose in the lower half to wholly pruinose; leaf base shallowly canaliculated; apex obtuse to acute. *Inflorescence* 1(-2), longer than the leaves, flaccid, *scape* 50-65 mm long, pruinose, compressed at base, glabrous; *rachis* ridged, raceme dense, cylindric, oblong, 46-166 × 30-43 mm, 50-120-flowered. *Bracts* without bracteoles, fleshy, 1.03-1.48 × 1.0-1.34 mm, deltoid, pink to purple. *Pedicels* spreading horizontally, (8-)11.6-21.0 mm long, white to light pink aging darker pink. *Perianth* 4.16-5.02 mm long, tepals recurved, oblong, 4.25-5.68 × 2.0-2.07 mm, equal, apex obtuse to slightly acute, weakly cucullate, green with a greenish purple keel. *Stamens* erect, filaments 2.4-3.6 mm long, dark pink to purple, epipetalous; anthers 0.85-0.97 mm long, pale violet. *Ovary* ovoid, 6-lobed, 0.8-1.0 × 1.5-1.7 mm, glabrous, lobes narrowly transversely oblong, apex shoulders raised, dorsal lobes prominent and papillate. *Style* 0.95-0.98(-1.5) mm long, glabrous, purple; stigma equal height than anthers; stipe 0.2 × 0.2 mm. *Flowering*: December to January (Fig. 28).

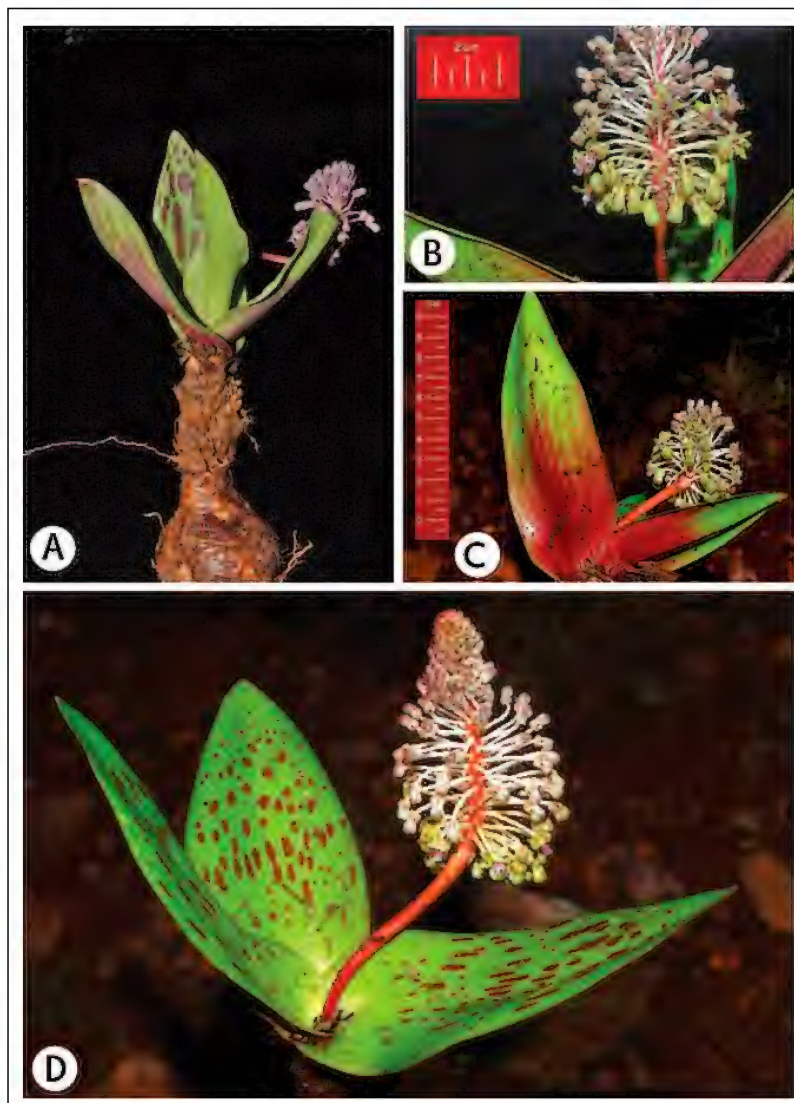


Fig. 28. *Ledebouria pardalotus*. **A**, plant showing the prominent neck to the bulb; **B**, inflorescence showing the ridged rachis and the prominent revolute leaf margin; **C**, the pruinose abaxial leaf surface; **D**, growth habit showing clearly the pruinose spots on the pea-green leaves and the pruinose scape. All from Lötter & Turpin 1315 (Photos by M. Lötter).

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA**Diagnostic Features:**

The brown dead bulb scales, prominent neck to the bulb, adaxial leaf surface glabrous, pea-green with pruinose blotches and spots, abaxial surface pruinose, dense flaccid inflorescence with long pedicels, green tepals with purplish keel and the papillate dorsal lobes of the ovary.

Discussion:

Ledebouria pardalota is related to *L. floribunda* but differs in the leaves lacking threads when torn, revolute leaf margin, inflorescence longer than the leaves, fleshy flower bracts without bracteoles, ovoid ovary with raised apex shoulders and papillate dorsal lobes. From *L. revoluta* it differs in the bulb scales and leaves with no threads when torn, pruinose abaxial leaf surface 1(-2) inflorescences, scape compressed at base, fleshy flower bracts and papillate basal lobes.

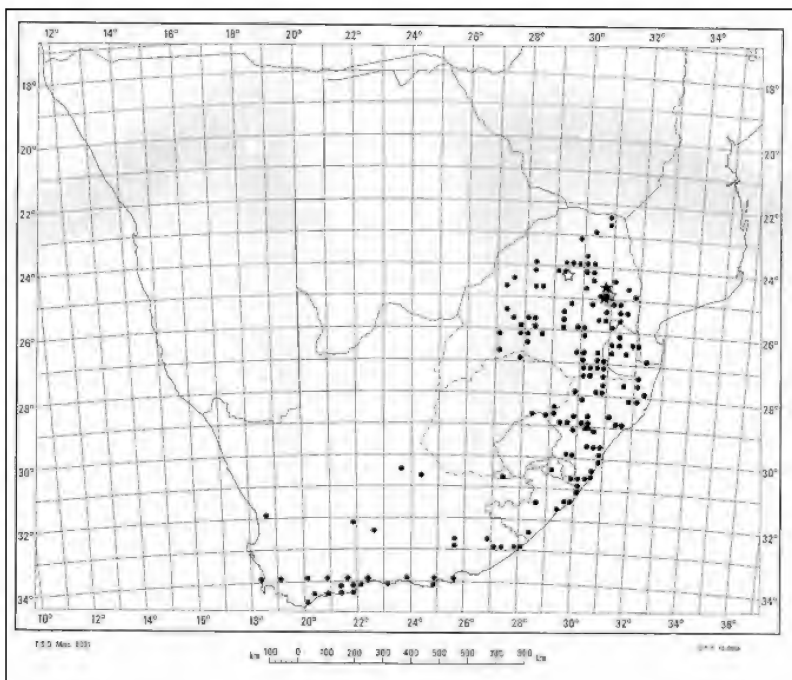


Fig. 29. Known distribution of *L. pardalota* (open circle), *L. parvifolia* (open stars), *L. pustulata* (filled triangle), *L. remifolia* (closed stars), *L. revoluta* (filled circles) and *L. rupestris* (double circle).

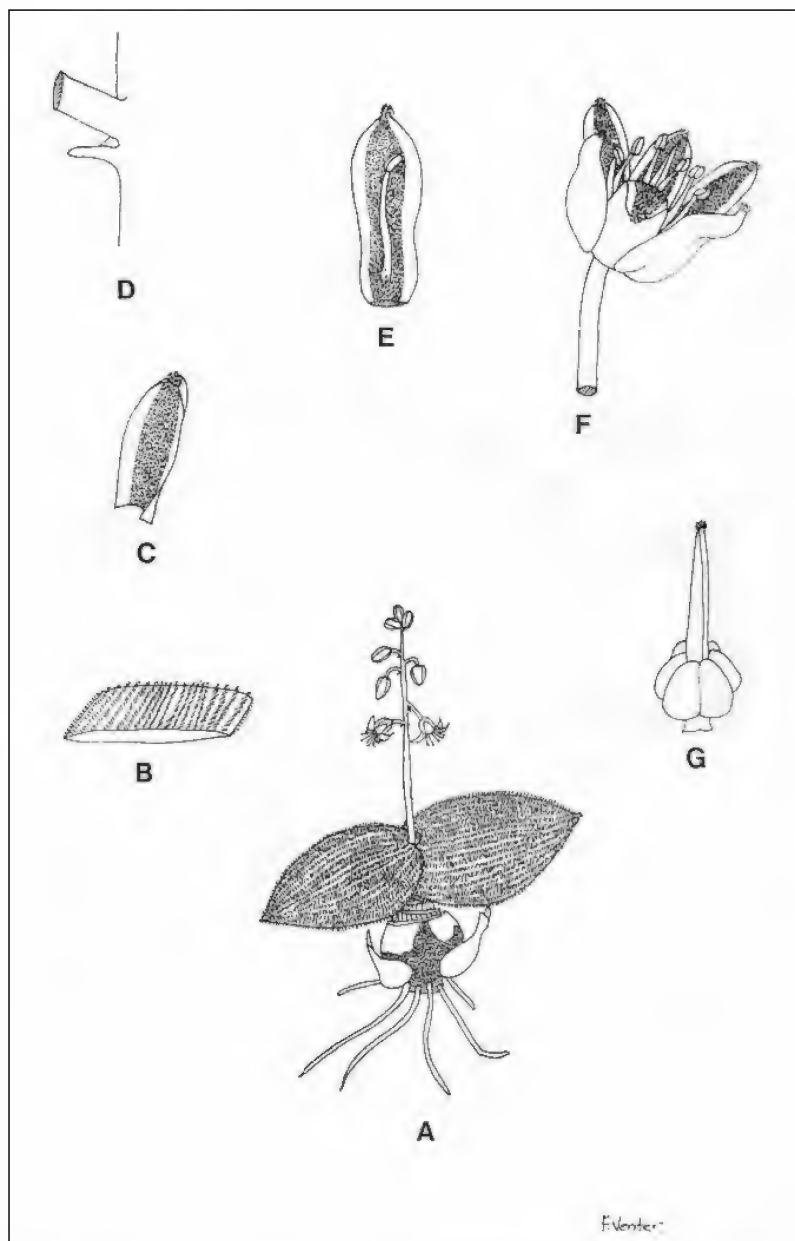


Fig. 30. *Ledebouria parvifolia*. **A**, habit $\times 2$; **B**, section through lamina $\times 2$; **C**, tepal $\times 5$; **D**, bract $\times 10$; **E**, tepal with stamen $\times 10$; **F**, flower $\times 5$; **G**, ovary lateral view $\times 10$. Drawn from Venter *s.n.*

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

29. *Ledebouria parvifolia* S. Venter, Bothalia 28 (2):180 (1998). Type: South Africa. Transvaal, Graskop, near Lisbon Falls, farm Lisbon 531 KT, Venter s.n. (PRE!, holo.).

Diagnostic Features:

Live bulb scales without threads when torn, bulblets present on basal stem, single cataphyll exerted above ground, leaves humifuse, with rows of hairs on adaxial lamina surface, inflorescence solitary, erect and lax, scape purple, rachis smooth, bracts fleshy and without bracteoles and the 3-lobed ovary.

Discussion:

L. parvifolia is related to *L. cooperi* but differs in its humifuse leaves with longitudinal rows of hair-like papillae, solitary, erect, lax inflorescence and 3-lobed ovary.

30. *Ledebouria pustulata* S. Venter, sp. nov., Type: South Africa.

KwaZulu/Natal Province, Muden, near the Mdumbeni River Bridge at Mt. Moriah, altitude 1200 m. 06.ii.1990. Venter 13463 (PRE!, holo.).

L. ovatifoliam (Bak.) Jessop in mentem vocat, sed pagina superiore foliorum dense papillis ad 0.5–1.0 longis obtecta, ovario valde parvo (0.5–0.8 × 0.6–1.0 mm) distinguitur.

Bulb 40–60 × 30–50 mm, elliptic to ovate, dead bulb scales brown, apices attenuate, with copious threads when torn, white inside, truncate, tightly appressed. *Leaves* fully emerged at anthesis, 4–6, humifuse to slightly spreading, ovate to broadly ovate, (40–)50–100 × (35–)40–60(–90) mm, with threads when torn, dull green to purplish green, adaxial surface covered in prominent papillae 0.5–1.0 mm high, abaxial surface glabrous; margin white and slightly wavy; leaf base shallowly canaliculated, apex acute. *Inflorescences* 1–4, flaccid, 30–70-flowered, shorter than the leaves; *peduncle* glabrous, flattened at base, green fused purple to purple, 20–40(–55) mm long; *rachis* longitudinally ridged; *raceme* dense, oblong, 30–40 × (30–)40–50 mm; *bracts* and bracteoles always present, membranous, 1.0–2.0 × 0.25–0.4 mm, linear, white. *Pedicels* spreading, 10–15 mm long, light pink to pink. *Tepals* strongly recurved, subequal, oblong, 6–8 × 1.5–2.0 mm, light greenish pink, keel green; apex obtuse and cucullate. *Stamens* erect, 2–3 mm long, filaments pink to maroon, epipetalous, anthers 0.9–1.0 mm long, violet. *Ovary* 6–

lobed, $0.5\text{--}0.8 \times 0.6\text{--}1.0$ mm, lobes narrowly transversely oblong, apex shoulders present, basal lobes present, smooth; stipe $0.15\text{--}0.5$ mm long; *style* $1.5\text{--}2.0$ mm long, terete, glabrous, maroon, stigma below anthers (Fig. 31).

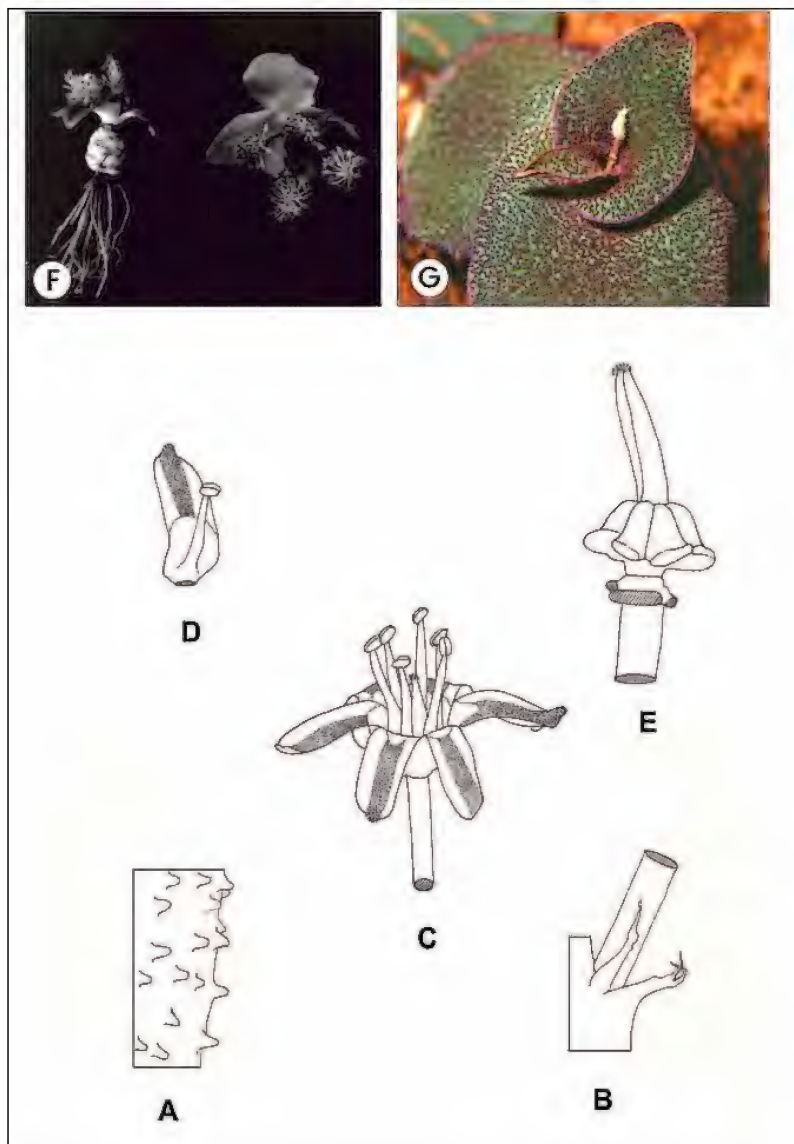


Fig. 31. *Ledebouria pustulata*. **A**, side and top view of the type plant showing the attenuate apices of the bulb scales; **B**, the heavily papillate adaxial surface of the leaves; **C**, flower; **D**, tepal with stamen; **E**, ovary, side view; **F**, papillae of the leaf; **G**, bract and bracteole. All from Venter 13463.

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA**Diagnostic Features:**

The truncate bulb scales, humifuse leaves with dense papillae on the adaxial surface, inflorescences shorter than the leaves, bracts and bracteoles always present, rachis ridged, tepals strongly recurved, ovary apex shoulders present, and the basal lobes glabrous.

Discussion:

Ledebouria pustulata is related to *L. ovatifolia* but differs in the adaxial lamina surface densely covered in 0.5-1.0 mm high papillae and the much smaller ovary (0.5-0.8 × 0.6-1.0 mm compared to 0.5-0.8 × 0.6-1.0 mm).

31. *Ledebouria remifolia* S. Venter, nom. nov.

Scilla petiolata Van der Merwe, Flower. Pl. S. Afr. 21:t.832 (1941). Type:

South Africa. Transvaal, North of Graskop, Strydom s.n. sub PRE 26397 (PRE!, holo.; iso!).

The epithet '*petiolata*' is already in use by Manning and Goldblatt (2004) for =*Ledebouria petiolata* (*Drimiopsis maculata*).

Diagnostic Features:

Leaf with a prominent petiole up to 30 mm long and thickened lamina margins, ridged rachis and fleshy bracts and bracteoles.

Discussion:

Cannot be confused with any other *Ledebouria* species. The long, thin petiole is unique in the genus.

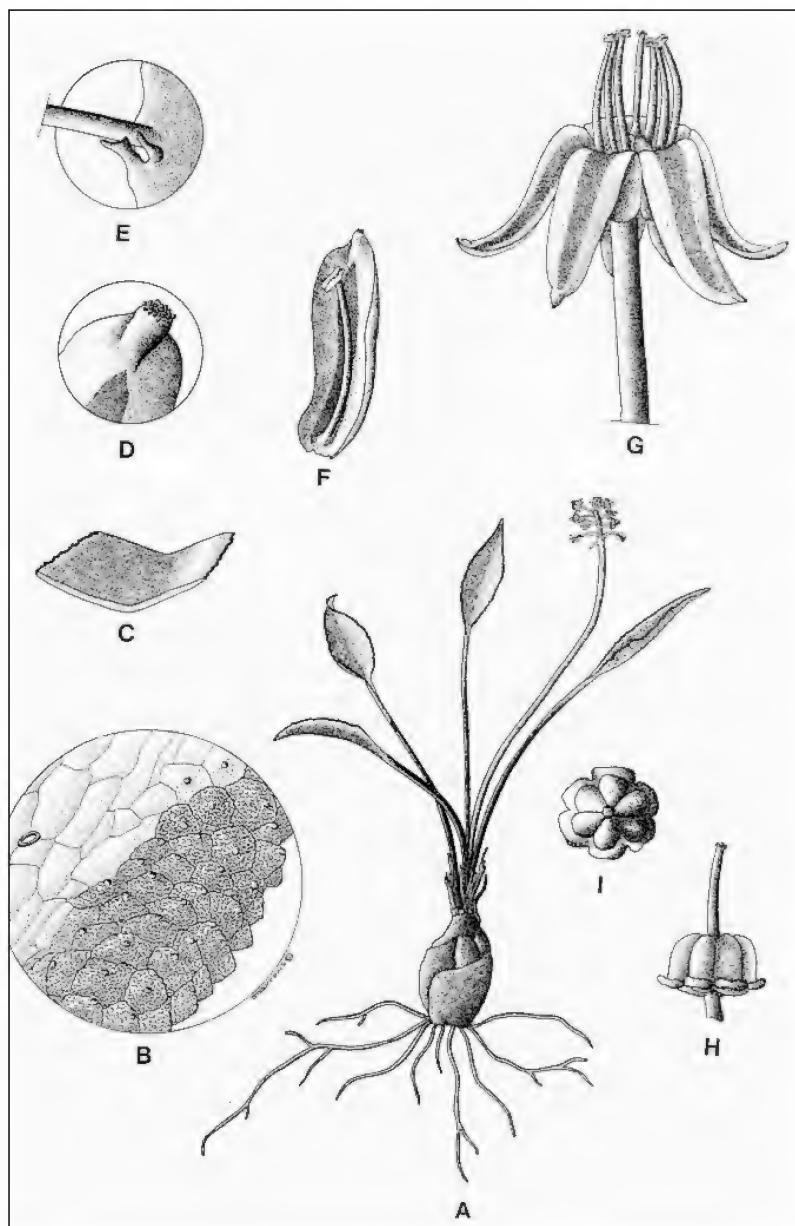


Fig. 32. *Ledebouria remifolia*. **A**, habit $\times 1$; **B**, lamina margin $\times 300$; **C**, section through lamina $\times 5$; **D**, apex of tepal $\times 20$; **E**, bract with bracteole $\times 10$; **F**, tepal with stamen $\times 10$; **G**, flower $\times 10$; **H**, ovary lateral view $\times 10$; **I**, ovary distal view $\times 10$. All from Middleton *s.n.*

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

32. *Ledebouria revoluta* (L.f.) Jessop in Journ. S. Afr. Bot. 36(4):255 (1970).
Hyacinthus revolutus L.f., Suppl. Plant.:204 (1781). Type: **South Africa**.
 Cape, Cap. bonae Spei, Thunberg s.n. (UPS, holo.; BOL & PRE!, on
 Herb. Thunb. Microfiche no. 8508).
Lachenalia lanceaefolia Jacq., Icones Pl. Rar. 2:t.402 (1794). Iconotype:
 Jacquin in Icones Pl. Rar. 2:t.402 (1794).
Phalangium revolutum (L.f.) Pers., Syn. Pl. 1:367 (1805). Type: **South
 Africa**. Cap. bonae Spei, Thunberg s.n. (UPS, holo.; BOL & PRE!,
 on Herb. Thunb. Microfiche no. 8508).
Lachenalia lanceaefolia Sims var. *maculata* Tratt., Archiv der
 Gawchskunde 2:132, t.168 (1814). Iconotype: Tratt. in Archiv der
 Gewchskunde 2:t.168 (1814).
Scilla maculata Schrank, Pl. Rar. Hort. Acad., Monac. 2:fol.100, t.100.
 "Promontium Bonae Spei". (1820). Iconotype: As for *Drimia
 lanceaefolia* Lodd. var. *longipedunculata* Schrader.
Ledebouria hyacinthina Roth, Nov. Pl. sp. Ind. Or.:195 (1821). Type:
India. Heyne s.n. (K, holo.).
Drimia acuminata Lodd., Bot. Cab.:t.1041 (1825). Iconotype: Lodd. Bot.
 Cab. : t.1041. "Cape of Good Hope" (1825).
Drimia lanceaefolia Lodd. var. *longipedunculata* Schrader, Blumenb.:30
 (1827). Iconotype: Pl. Rar. Hort. Acad., Monac. 2.:fol.100, t.100
 "Promontium Bonae Spei" (1819).
Eratobotrys bifolia A. Rich., Tent. Fl. Abyss. 2:326 (1850). Type: **Ethiopia**.
 Walcha Plateau, Schimper 1622 (P, holo., K. iso.).
Scilla indica Baker, Saunders Refug. Bot. 3, Append. 12 (1870), nom. ill
 git. Type: same as *Ledebouria hyacinthina*.
Scilla revoluta (L.f.) Baker, Saund. Ref. Bot. 3(app.):6(1870). Type: **South
 Africa**. Cape, Caledon Div., on Donker Hoek mountain, Burchell
 7982 (K, holo.).
Scilla richardiana Baker, Saunders Refug. Bot. 3, Appen. 11 (1870). Based
 on *Eratobotrys bifolia* A. Rich. fide Stedje & Thulin (1995).
Scilla spathulata Baker, Saund. Ref. Bot. 3:t.187 (1870). Iconotype:
 Saund. Ref. Bot. 3:t.187, "South Africa. Cape of Good Hope,
 Cooper s.n." (1870).
Scilla livida Baker, Gdnrs' Chron. 20:166 (1883). Type: **South Africa**.
 Cape of Good Hope, Hort. F. Horsman & Co. (K!, holo.; PRE!,
 photo.; BOL!, drawing).

- Scilla polyantha* Baker var. *angustifolia* Baker, Flora Cap. 6:488 (1896).
Type: **South Africa**. Transvaal, Saddleback Mountain, Barberton,
Galpin 1096 (PRE!, holo.).
- Drimia brevifolia* Baker, F.T.A. 7:527 (1898). Type: **Somalia/Ethiopia**
border. Near The River Daua, at Dolo. Riva 1251 (B, holo., FT, iso.).
- Scilla neumannii* Engl., E.J. 32:95 (1902). Type: **Ethiopia**. Gara Mulata.
Ellenbeck 490 (B, holo.).
- Scilla moschata* Schnl., Rec. Albany Mus. 3:60 (1914). Type: **South Africa**.
Cape, Stutterheim, Rogers 12786 (GRA!, holo.; PRE!, photo.).
- Scilla hyacinthina* (Roth) Macbr., Contr. Gray Herb. 56:14 (1918).
- Scilla chiovenda* Cufod., Miss. Biol. Borana, Racc. Bot.:320 (1939). Types:
Ethiopia. Neghelle. Cufodontis 170, 199 & 229 (FT, syn.).
- Scilla carnosula* Van der Merwe, Flower. Pl. S. Afr. 24:t.958 (1944). Type:
South Africa. Natal, near Greytown, Van der Merwe 2592 (PRE!,
holo.).

Diagnostic Features:

Live bulb scales with threads when torn, leaves fully developed at anthesis, with threads when torn, inflorescences 4–10, dense, flaccid with more than 30 flowers per raceme, rachis ridged, bracts and bracteoles membranous, anthers pale yellow, ovary 6-lobed, distal lobes present and the seeds brown.

Discussion:

L. revoluta is closely related to *L. hypoxidioides* but *L. hypoxidioides* is easily separated from *L. revoluta* in the hairy leaves.

33. *Ledebouria rupestris* (Van der Merwe) S. Venter, comb. nov., Type:
South Africa. Transvaal, near Mac Mac and Sabie. Van der Merwe 1586
(PRE!, holo.).

Scilla rupestris Van der Merwe, Flower. Pl. S. Afr. 21:t.828 (1941).

Diagnostic features:

The petiolate leaves with adaxial asperities easily distinguish *L. rupestris*.

Discussion:

L. rupestris is closely related to *L. minima* but differs in the leaves and bulb scales that lack threads when torn, leaves are monochromatic, racemes lax with a smooth rachis, bracts fleshy and the stellate flowers with acute tepals.

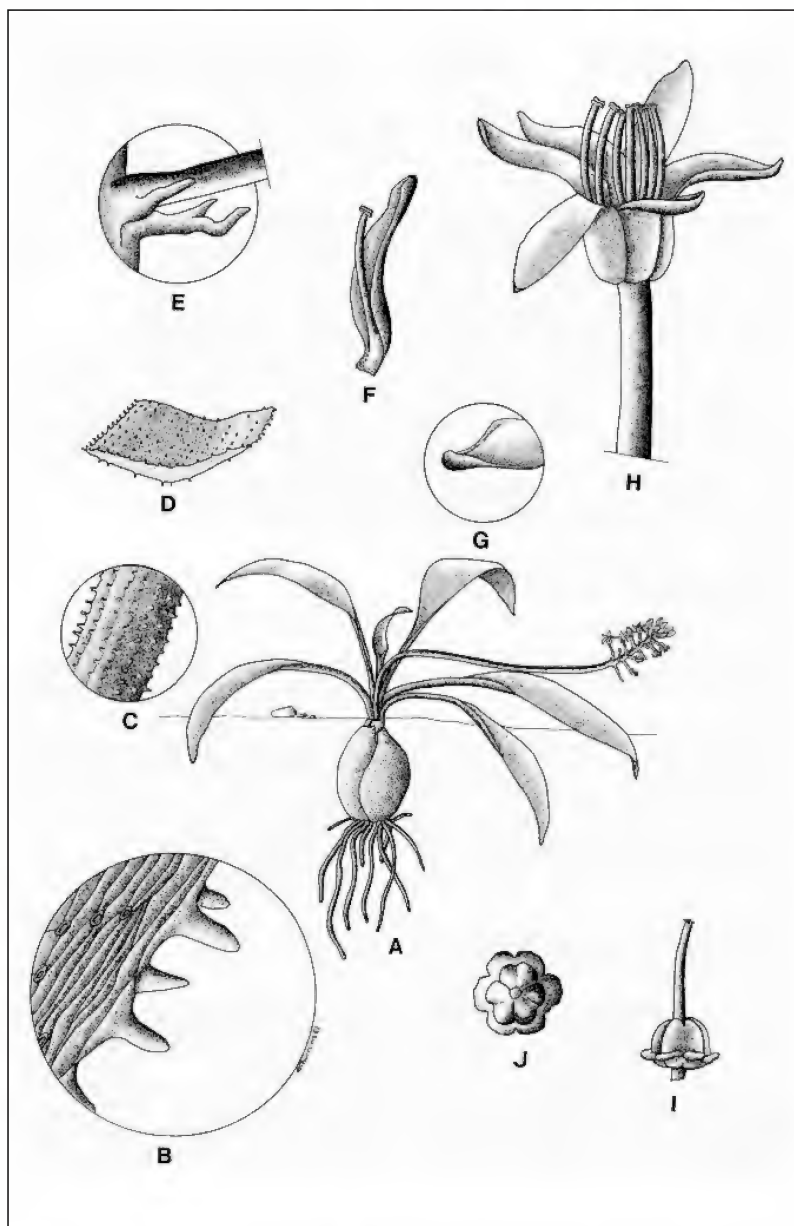
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 33. *Ledebouria rupestris*. A, habit $\times 2$; B, lamina margin $\times 300$; C, section of the peduncle $\times 10$; D, section through lamina $\times 5$; E, bract with bracteole $\times 10$; F, tepal with stamen $\times 10$; G, tepal apex $\times 20$; H, flower $\times 10$; I, ovary lateral view $\times 10$; J, ovary distal view $\times 10$. All from Venter 13250.

34. *Ledebouria sandersonii* (Baker) S. Venter & T.J. Edwards, Bothalia 33 (1):50 (2003). Type: **South Africa**. Transvaal, s. loc., Sanderson s.n. (K!, holo.; PRE!, photo).
- Scilla sandersonii* Baker, Saund. Ref. Bot. 3 (App.):5 (1870). Type: Same as for *L. sandersonii*.
- Scilla baurii* Baker, Flora Cap. 6:484 (1896). Type: **South Africa**. Cape, Tembuland, Bazeia Mountain. Bauer 550 (K!, holo.; PRE!, photo.; SAM!).
- Scilla tysonii* Baker, Flora Cap. 6:484 (1896). Type: **South Africa**. Cape, Griqualand East. Tyson s.n. (K!, holo.; BOL! & GRA!, drawing).
- Scilla oostachys* Baker, Flora Cap. 6:487 (1896). Type: **South Africa**. Natal, Upper Umkomaas. Wood 4627 (K!, holo.; NH!; PRE!, photo.; BOL!, drawing).
- Scilla diphylla* Baker, Flora Cap. 6:489 (1896). Type: **South Africa**. Transvaal, Barberton, Saddleback Range. Galpin 1182 (K!, holo.; BOL!; GRA!; NH!; PRE!; SAM!).
- Scilla bella* Markötter, Ann. Univ. Stell. 8 (Sec. A No. 1.):13 (1930). Type: **South Africa**. Natal, Olivier's Hoek Pass. Thode s.n. sub STE 3372 (STE!, holo.; PRE!, photo.).

Diagnostic Features:

Live bulb scales loosely arranged and without threads when torn, leaves fully developed at anthesis, abaxial lamina surface purple, venation obscure, rachis and scape smooth, bracts fleshy and dentate, tepal apices acute, ovary six-lobed with the apex tapering into the style and the base of the lobes with papillate nectaries.

Discussion:

Ledebouria sandersonii is related to *L. apertiflora* and *L. ensifolia* in having bulb scales without threads when torn, having fleshy bracts and markedly acute tepal apices. It differs however in the thin fleshy roots, loosely arranged live bulb scales, ovate to lanceolate leaves and dense oblong raceme.

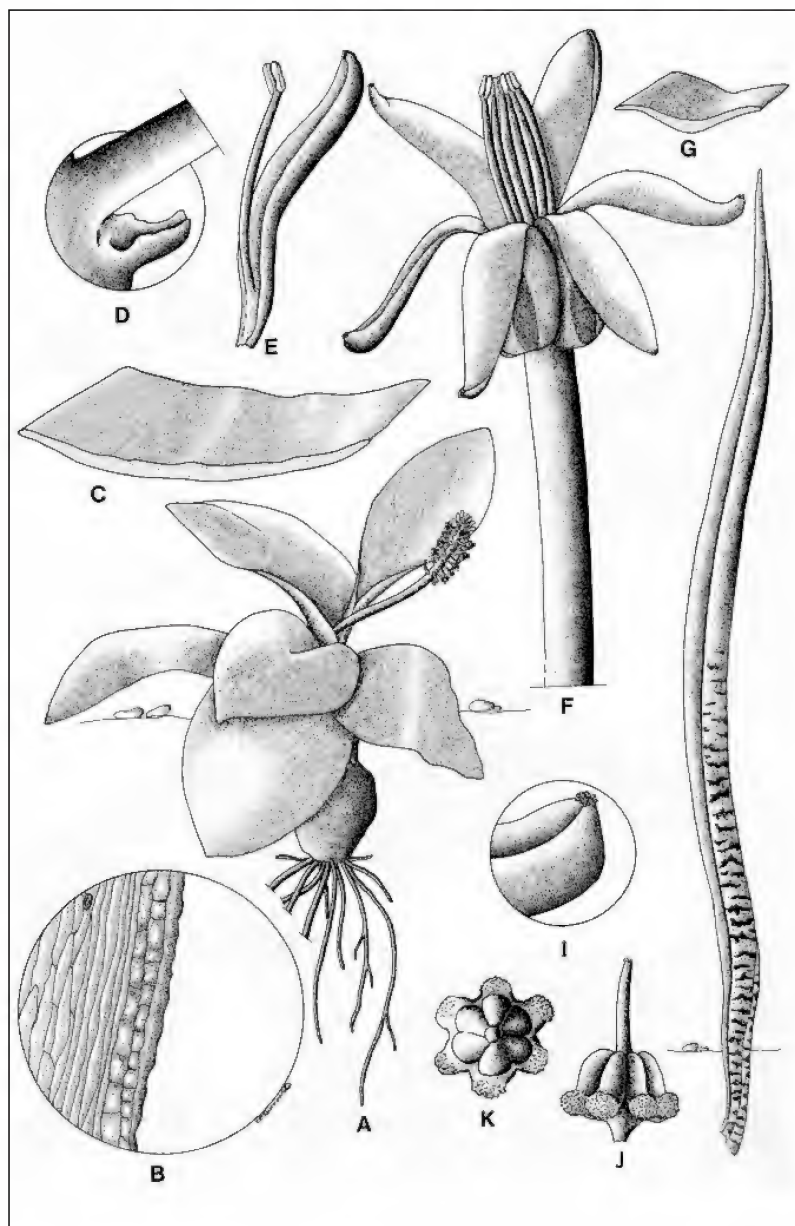
SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

Fig. 34. *Ledebouria sandersonii*. A, habit $\times 1$; B, lamina margin $\times 300$; C, section through lamina $\times 2$; D, bract $\times 10$; E, tepal with stamen $\times 10$; F, flower $\times 10$; G, section through lamina depicted in H, $\times 2$; H, lamina, shade form $\times 1$; I, tepal apex $\times 20$; J, ovary lateral view $\times 10$; K, ovary distal view $\times 10$. A - F from Crouch 7 and H to K from Venter 13464.

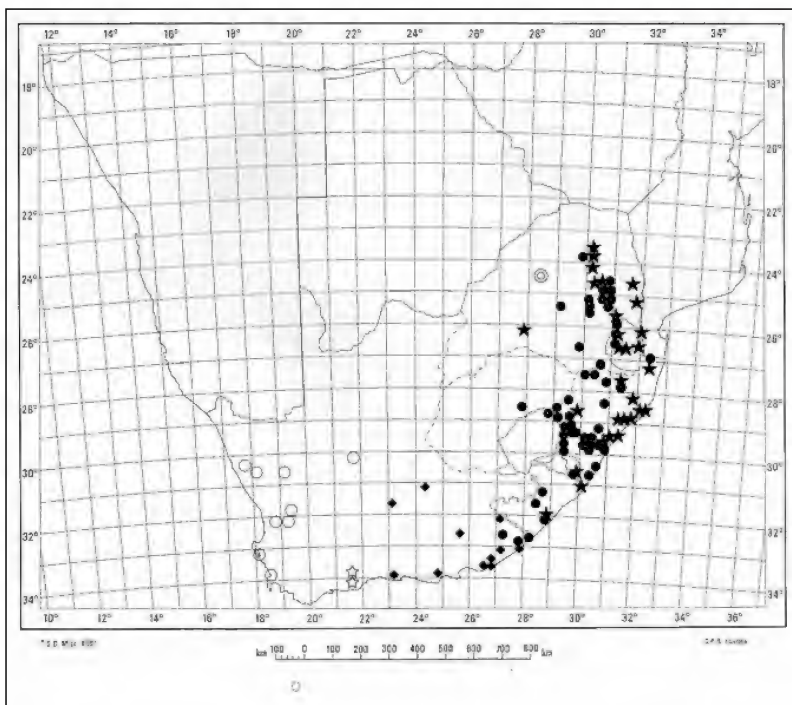


Fig. 35. Known distribution of *L. sandersonii* (solid circles), *L. socialis* (filled diamonds), *L. venteri* (open stars), *L. undulata* (open circles), *L. viscosa* (double circle) and *L. zebrina* (filled stars).

35. *Ledebouria socialis* (Baker) Jessop, Journ. S. Afr. Bot. 36(4):253 (1970).
Scilla socialis Baker, Saund. Ref. Bot. 3:t.180 (1870). Type: South Africa. Natal, without precise locality, Cooper 3635 (K!, holo.; PRE!, photo.).
Scilla paucifolia Baker, Saund. Ref. Bot. 3:t.181 (1870). Iconotype: Saund. Ref. Bot. 3:t.181, "South Africa. Cape, Cooper s.n." 1870.
Scilla laxiflora Baker, Gdnr's Chron. 9:668 (1891). Type: Hortus N.E. Brown, Kew. (K!, holo.; BOL!, drawing).
Scilla violacea Hutch., Kew Bull.:511 (1932). Type: South Africa. Cape, Uitenhage Div., Hankey, Hutchinson & Long s.n. (K!, holo.; BOL!; PRE!).
Ledebouria violacea (Hutch.) W.L. Tjaden, British Cactus and Succ. Journ. 7(1):11 (1989).

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA**Diagnostic Features:**

L. socialis is the only species with epigeal bulbs, an erect inflorescence and small flowers with strongly reflexed lobes.

Variation: The leaf colour variation has caused confusion since 1870 in horticultural circles. Plants in cultivation originated from collections of green-leaved, mottle-leaved and silvery-leaved forms, the latter being the most popular. This resulted in Tjaden (1989) making the new combination *Ledebouria violacea* (Hutch.) W.L. Tjaden based on leaf colour only.

Discussion:

L. socialis is closely related to *L. macowanii* but differs in having epigeal bulbs.

36. *Ledebouria undulata* (Jacq.) Jessop, Journ. S. Afr. Bot. 36(4): 258 (1970).

Drimia undulata Jacq., Icones Plantarum Rariorum 2(15):t.376 (1794).

Iconotype: Icones Plantarum Rariorum 2(15):t.376 (1794).

Scilla undulata (Jacq.) Baker, Saund. Ref. Bot. 3(Append.):11 (1870).

Nom. illegit., non *S. undulata* Desf., 1798.

Scilla undulatifolia Von Poelln., Ber. dt. Ges. 41:209 (1944). Type: As for

Drimia undulata.

Diagnostic Features:

L. undulata is the only hysteranthous species of *Ledebouria*. In leaf it is easy to identify by the fleshy texture and dull green to glaucous colour.

Discussion:

L. undulata is not related to any other *Ledebouria* species.

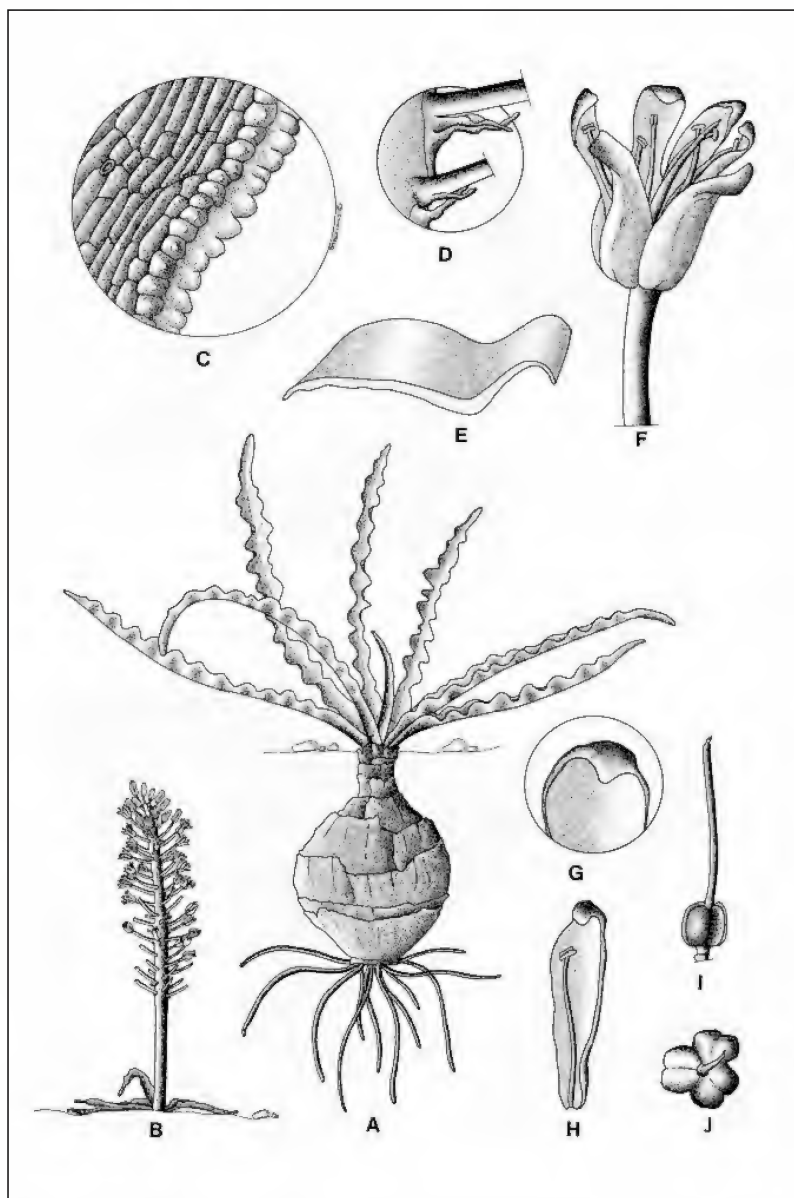


Fig. 36. *Ledebouria undulata*. **A**, habit, leafing period $\times 1$; **B**, habit, flowering period $\times 1$; **C**, lamina margin $\times 300$; **D**, bracts with bracteoles $\times 10$; **E**, section through lamina $\times 4$; **F**, flower $\times 10$; **G**, apex of tepal $\times 20$; **H**, tepal with stamen $\times 10$; **I**, ovary lateral view $\times 10$; **J**, ovary distal view $\times 10$. **A** and **C** - J from Müller-Doblies 89129 and **B** from Hall 3200.

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

37. *Ledebouria venteri* Van Jaarsv. & A.E. van Wyk, Aloe 43(4):75-77 (2006).

Type: South Africa. Western Cape, Gouritz Poort. Van Jaarsveld 17633 (NBG, holo.).

Diagnostic Features:

Semi-epigeal to epigeal bulbs; succulent, unspotted, linear-lanceolate leaves with a white margin and the free and fully reflexed tepals.

Discussion:

Ledebouria venteri is related to *L. concolor* but the bulbs are globose, the dry bulb scales are thin and papery with an indistinct transverse abscission layer, rachis ridged, bracts prominent and the tepals purplish green.



Fig. 37. *Ledebouria venteri*. Artist: Jeanette Loedolff. (Courtesy Aloe).

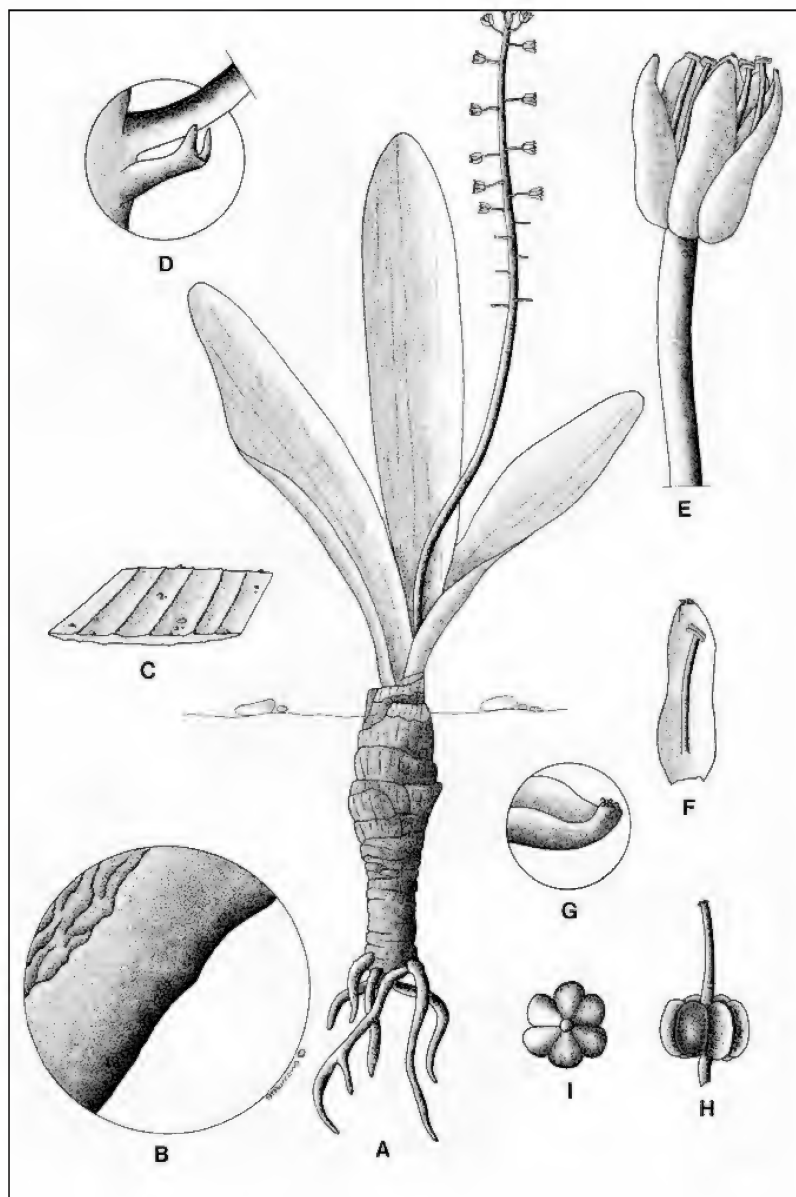


Fig. 38. *Ledebouria viscosa*. **A**, habit $\times 1$; **B**, lamina margin $\times 300$; **C**, section through lamina $\times 2$; **D**, bract $\times 10$; **E**, flower $\times 10$; **F**, tepal with stamen $\times 10$; **G**, tepal apex $\times 20$; **H**, ovary lateral view $\times 10$; **I**, ovary distal view $\times 10$. All from Venter 13455.

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

38. *Ledebouria viscosa* Jessop, Journ. S. Afr. Bot. 36(4):264 (1970). Type: South Africa. Transvaal, Thabazimbi, Kransberg, Meeuse 10493 (PRE!, holo.).

Diagnostic Features:

The cylindrical bulb with long basal stem, erect leaves covered with a resinous layer and the solitary lax inflorescence, bifurcate membranous bracts without bracteoles, almost tubular perianth and prominent apex shoulders of the ovary.

Discussion:

L. viscosa cannot be confused with other *Ledebouria* species in South Africa. The erect viscid leaves and solitary erect inflorescence are diagnostic.

39. *Ledebouria zebrina* (Baker) S. Venter, comb. nov., Type: South Africa. "Cape of Good Hope, Cooper s.n.," Iconotype: Saund. Ref. Bot. 3:t.185 (1870).

Scilla zebrina Baker, Saund. Ref. Bot. 3:t.185 (1870).

Scilla microscypa Baker, Gdnr's Chron. 16:102 (1881). Type: South Africa. Cape, eastern Provinces, Bowker s.n. (K!, holo.; PRE!, photo.).

Scilla megaphylla Baker, Flora Cap. 6:490 (1896). Type: South Africa. Transvaal, near Barberton, Galpin 1184 (GRA!, lecto.; NH!, PRE!, photo.; SAM!) (lecto. selected here - Art. 9.3, Greuter et al. 1988).

Scilla grandifolia Schönl., Rec. Albany Mus. 3:61 (1914). Type: South Africa. Transvaal, Tzaneen, Duiwelskloof, F.A. Rogers s.n. (GRA!, holo.; PRE!, photo.).

Diagnostic Features:

Leaves large (300-500 × 90-120 mm), leaf base flat to shallowly canaliculate; inflorescences many (4-10), scape base winged to angled, bracteoles below membranous bracts, tepals light green with darker green keels and apex tapering into the white to light green style.

Discussion:

Discussion: Resembles large plants of *L. floribunda* but the leaves are far larger, more than double the number of inflorescences and the flowers are green.

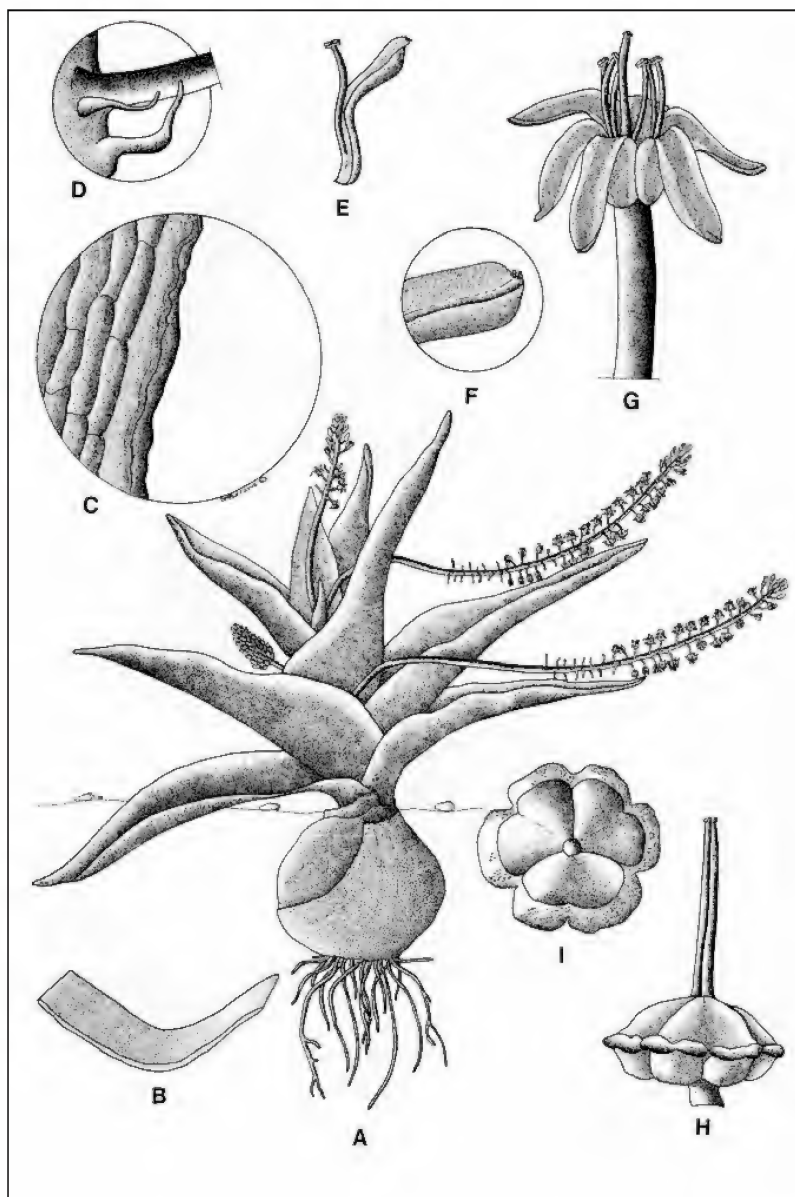


Fig. 39. *Ledebouria zebrina*. **A**, habit $\times 0.25$; **B**, section through lamina $\times 0.5$; **C**, lamina margin $\times 300$; **D**, bract with bracteole $\times 5$; **E**, tepal with stamen $\times 5$; **F**, apex of tepal $\times 10$; **G**, flower $\times 5$; **H**, ovary lateral view $\times 10$; **I**, ovary distal view $\times 10$. All from Venter 13395.

SYNOPSIS OF THE GENUS *LEDEBOURIA* ROTH (HYACINTHACEAE) IN SOUTH AFRICA

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THE ATAMASCO AND SIMPSON RAINLILIES

Victor W. Lambou
272 Pine Lane
Crawfordville, FL 32327 USA
E-mail: Vwak@msn.com

ABSTRACT

The ecology, taxonomy, and hybridization of southeastern United States native rainlilies *Zephyranthes atamasca*, *Z. treatiae*, and *Z. simpsonii* are reviewed. The descriptions of these species, as well as the habitats in which they occur, vary considerably among the various authorities. It is concluded that *Z. treatiae* is not a valid species and should be considered a variety of *Z. atamasca*. The *Z. atamasca* rainlilies are extremely varied and range from clones with narrow hair-like leaves to clones with wide leaves occurring in both lowlands and highlands. Weather and soil moisture play a major role in determining their bloom and growth cycle. *Z. atamasca* can serve both as a pod and pollen parent in hybridizing with other rainlilies. *Z. simpsonii* is usually considered as originally being restricted to Florida; however, disjunct populations probably resulting from introductions and/or escapes have been reported from Alabama, Georgia, Mississippi, North Carolina, and South Carolina. These rainlilies are excellent garden and landscape plants, well adapted to the warm humid climates of the southern United States.

INTRODUCTION

Questions are often raised relative to the ecology, taxonomy, and hybridization of southeastern United States native rainlilies *Zephyranthes atamasca* (L.) Herb. 1821, *Z. treatiae* S. Wats. 1879, and *Z. simpsonii* Chapm. 1892. I have been actively observing wild populations of these species, growing them, and trying to research all the available information on them for a number of years. The purpose of this report is to try to clear up some of the confusion relative to these rainlilies and to summarize what is known about them.

Linnaeus first described *Z. atamasca* in 1753 as *Amaryllis atamasca*, and Herbert transferred it to the new genus *Zephyranthes* in 1821. Parkinson first discussed this rainlily in the literature in 1629. The scientific name *Z. atamasca* and common name Atamasco rainlily were derived from “attamusco” meaning it is red, which was used by speakers of Algonquian (Indian) language in Virginia in reference to the flowers turning from white

to pink as they aged. According to Hume (1935), *Z. treatiae* was first described by Sereno Watson in 1879 and was discovered in the vicinity of Green Cove Springs, Florida, by Mary Treat, a naturalist from New Jersey who spent the winters of 1876-77-78 in Florida. Also, according to Hume, *Z. simpsonii* was first found in the vicinity of Bradenton, Florida by J. H. Simpson, a botanist and plant collector, and was formally named by Dr. A. W. Chapman in 1892.

The Seminole Indians collected these bulbs for use in treating toothaches, and old-timers tell stories of collecting bulbs for sale to dealers who sold them for medicinal purposes. There are reports of cattle, horses, and chickens staggering after eating the leaves of the Atamasco rainlily, leading to them sometimes being called "stagger-grasses." Supposedly, the leaves and bulbs contain a cocktail of alkaloids, some of which may be quite poisonous; the bulb is reputed to be the most toxic.

If one is serious about learning and understanding the ecology, taxonomy, and culture of these rainlilies, Fellers' (1996) excellent paper "A Passion for Rainlilies: *Cooperia*, *Habranthus* and *Zephyranthes*" is required reading. You may or may not agree with everything he states in his paper; nevertheless, it is an invaluable starting off point.

GEOGRAPHIC RANGE OF MY OBSERVATIONS

I have been actively observing these rainlilies in the southeastern United States from the Apalachicola River Basin in Florida east to Cedar Keys, Florida; north from the mouth of the Apalachicola River into southern Georgia to the approximate latitude of Thomasville, Georgia; west to about Valdosta, Georgia; and then southeast to Cedar Keys, Florida. Since I live in Wakulla County, Florida, the majority of my observations have been made in Wakulla and the adjoining counties of Franklin, Liberty, Leon and Jefferson.

IDENTIFYING THE SPECIES

Some of the distinguishing characteristics taken from the literature are given in Tables 1 and 2. As can be seen from the Tables, the descriptions of these species, as well as the habitats in which they occur, vary considerably among the various authorities.



Fig. 1. A *Zephyranthes atamasca* bloom from Wakulla County, Florida. (Photograph by Karla Brant.)



Fig. 2. Two *Zephyranthes atamasca* blooms from along US Highway 98, Jefferson County, Florida. (Photographs in Fig. 2 through 7 are by the author.)

SPECIES STATUS OF *Z. TREATIAE* AND *Z. ATAMASCA* POPULATION TYPES

Meerow (1985) demotes *Z. treatiae* to the level of a variety, i.e., *Z. atamasca* var. *treatiae*. Fellers (1996) states that there are two schools of thought whether or not *Z. treatiae* is a separate species. He further states: "After reviewing the descriptions of the varieties and discussions presented by the authors some impressions come to mind. 1. The authors described one of the several narrow-leafed rainlily varieties found in South Georgia and North Florida locations: or, even the dainty little variety further south in Florida. 2. Another author could be describing a natural hybrid between a Florida *Z. atamasca* and the variety that Mrs. Mary Treat found near Green Cove Springs, Florida and Sereno Watson described in 1879." If I am interpreting Fellers correctly, he believes that all of the *Zephyranthes* called *Z. treatiae* are actually narrow-leafed varieties of *Z. atamasca* with the exception of the *Z. treatiae* found in a limited area between Jacksonville, Florida and the Okefenokee Swamp.

Meerow points out that it is chiefly on foliage characters that *Z. treatiae* and *Z. atamasca* have been separated as species and that floral characteristics are much less reliable in separating these rainlilies. Spencer (1973) also questions the validity of *Z. treatiae* as a separate species and points out that chromosome complements of the two forms are cytologically indistinguishable. Spencer further states that according to a personal communication she had with Dr. W. S. Flory, when the two taxa were cross-pollinated in both directions there were no segregations of morphological characters among second generation progeny, and that *Z. treatiae* was probably a physiological variant of *Z. atamasca* that occurred when the bulbs of the latter were grown in the drier locations attributed to *Z. treatiae*.

Flagg (1961) in his PhD thesis states that floral characteristics do not reliably distinguish these taxa and that the demarcation between these two taxa is not absolutely clear. However, subsequently Flagg, Smith & Flory (2002) state: "It has generally been thought that *Zephyranthes atamasca* and *Z. treatiae* are distinguishable only by differences in leaves and habitat, and that their flowers are not significantly different. However, the greater length of the perianth tube compared with that of the filaments in *Z. treatiae* readily separates that species from *Z. atamasca*." According to them, the perianth tube for *Z. atamasca* is approximately " $\frac{1}{2} (\frac{1}{3} - \frac{2}{3})$ filament length" and for *Z. treatiae* it is " \pm equaling $(\frac{2}{3} - \frac{11}{4})$ filament length." However, no data are presented on how the perianth tube being less or greater than $\frac{2}{3}$ of the filament length is arrived at as a demarcation between *Z. treatiae* and

Z. atamasca. Apparently, they will publish on this in the future.

I have 23 different clones of *Z. atamasca* in cultivation and some of these would be considered to be *Z. treatiae* by some of the diagnostic characteristics given in Table 1. Most of these Atamasco rainlilies I have collected from the wild in North Florida; a few have come from other sources and originated in more northern climates. The width of the mature leaves of the plants originating in Florida ranges from less than 1 mm to more than 5 mm and this approximates what I have observed in the wild. I find a continuum in the width of the leaves and all of the other diagnostic characteristics including perianth tube characteristics. Furthermore, the same plant can sometimes be keyed to *Z. atamasca* by one character and to *Z. treatiae* by another. Also, I find both wide-leaved and narrow-leaved *Z. atamasca* clones occurring in the more upland types of habitat as well as in lowland types of habitat. The only attribute that I find to be consistent is that the narrow-leaved clones have smaller flowers than the wide-leaved clones.

Fellers points out that it has been argued that when seedlings from the piney-woods strains termed *Z. treatiae* are planted in conditions similar to flood plains, the progeny produce wide leaves and larger flowers equivalent to the size of flood-plain strains. Flagg (1961) refers to an accession of *Z. atamasca* by R. K. Godfrey of Florida State University from Florida's Marianna State Park. According to Flagg, when it was collected, it was definitely identified as *Z. atamasca*, based on the type of leaf; however, when cultivated in pots in a greenhouse it produced leaves characteristic of *Z. treatiae*. Undoubtedly, environmental conditions do affect the size of the leaves and flowers; however, when I grow these plants in my garden under identical conditions, I still have narrow-leaved and wide-leaved plants. Genetics undoubtedly is playing some role here.

Tony Avent (2003) comments that there appears to be two distinct ecotypes of *Z. atamasca*, one growing in bogs and the other in dry uplands. He further states that near Tallahassee in the spring he saw high and dry populations growing atop tall rocky cliffs with hepaticas and trilliums and, only a few hours east, growing in flat roadside ditches regularly filled with standing water. I have also observed this. Many of the populations south of Tallahassee grow in low open areas that are sometimes boggy and flood. I refer to these as the coastal open-land *Z. atamasca* populations. These are very common along the shoulders and ditches of Highway 98 in Wakulla County and east to Perry.

Zephyranthes atamasca also occurs in coastal forested, low-land flat-

woods habitats which I refer to as the coastal flatwoods populations. These occur in the St. Marks wildlife refuge in Wakulla County and elsewhere in the Florida Panhandle. Morphologically they appear identical to the coastal open-land population but are not as abundant.

Away from the coastal area and extending up into Georgia occurs a type found in wooded upland areas on hillsides, cliffs, river bluffs, and ravine slopes and often in associations with plants such as red buckeye (*Aeculus paui*) and *Trillium* spp. For the most part these seem to shy away from open areas and highway shoulders and ditches and can often be found in very shady habitats. I refer to these as the upland-woods *Z. atamasca* populations. They can be observed along some sections of Highway I-10 west of Tallahassee and along the Florida side of Lake Seminole. It has been suggested by some that these upland-woods *Z. atamasca* type are *Z. treatiae*. The width of the leaves of many of these plants range from 4 to 5 mm and this and other characteristics would identify many of them as *Z. atamasca* and not *Z. treatiae* in the various keys.

Are these coastal open-land, coastal flatwoods and upland-woods *Z. atamasca* genetically different or can the interaction of soil moisture, temperature, light intensity and other environmental conditions explain the differences in the type of habitat where they grow? Probably the only real way to know for certain would be to conduct experiments growing them under controlled conditions and/or conduct DNA studies. This would make a wonderful thesis for a PhD student

Even though I can grow them, I find that strains of the Atamasco rainlily from northern areas are not as vigorous and do not flower as well in my garden as do strains originating from more southern areas. Hayward (1947) reports that in Central Florida he lost hundreds of bulbs obtained from as far north as the Carolinas after a few years, while Atamasco rainlilies from the vicinity of Tallahassee, Florida survived well.

Is *Z. treatiae* a valid species? In my opinion, no. I believe what most others and I have been observing are just different strains of *Z. atamasca*. This may partially explain why the description of these species varies so much among the various authorities (Table 1). Wunderlin (1998) in his Guide to the Vascular Plants of Florida recognized *Z. treatiae* as a valid species; however, he and Hansen (2003) in their Atlas of Florida Vascular Plants list it as a variety of the Atamasco rainlily (*Z. atamasca* var. *treatiae*), evidently based on Meerow's (1985) publication. I believe that at the most, *Z. treatiae* should be considered to be a variety of *Z. atamasca*.

However, there is possibly one exception. Fellers (1996) refers to the original description of *Z. treatiae* where the color of the leaves are to referred to as “glaucous” and he states if this means “yellowish green,” one of the definitions in the dictionary, there is a variety he found in a limited region between Jacksonville, Florida and the Okefenokee Swamp that fits this description. (Standard botanical usage usually defines “glaucous” as “covered with fine, waxy, whitish, grayish, or blue coating that rubs off easily.”) Fellers states that this rainlily: (1) has leaves 2-2.5 mm wide which are concave, thick, crescent shaped, resembling *Z. citrina* leaves but are more yellowish and turn more yellowish green with age, (2) holds some leaves much of the year, and (3) has leaves which are tough, wiry and feel slick to the touch. As I have never seen this rainlily in the wild or in cultivation, I cannot comment on it, except to say that Fellers appears to be a very careful observer.

The Atamasco rainlilies are extremely varied. They range from clones with narrow hair-like leaves to clones with wide leaves and they occur in lowlands and highlands. The leaves can be upright or prostrate like a clone I collected from a highway shoulder. Prostrate leaves should be a rather good defense against the ravages of mowers operated by overzealous road maintenance crews.

THE ATAMASCO RAINLILY

Range

Fellers (1996) gives the northern range of *Z. atamasca* extending from the Atlantic Ocean approximately across the southern border of Plant Hardiness Zone 7, across the Chattahoochee River for about 100 miles into Central Alabama and then extending northward along the Atlantic Coastline upward into Virginia. He states it extends south into Florida about through Zone 9. He believes that reports of *Z. atamasca* being found in locations to the north and west of the range stated are probably escapes transported by people during earlier times and states that bulbs known to have been transplanted to east Texas about 40 years ago are reported to be thriving as natives. Turley (1999) found a lone colony of a very southern variant of *Z. atamasca* in a citrus grove near Immolalee, which is in south Florida west of Naples. Flagg, Smith, & Flory (2002) report it occurring in Alabama, Georgia, Maryland, Mississippi, North Carolina, South Carolina and Virginia.

The Flower

The blooms of the *Z. atamasca* rainlily are very attractive and when many of them are blooming in unison the display is most striking (Figs. 1 – 7). As many others have observed, *Z. atamasca* produces an extremely large flower for the size of the bulb. Fellers (1996) states that blooms up to 6 inches across the perianth are not uncommon. I have observed blooms from approximately $2\frac{1}{2}$ to $6\frac{1}{2}$ inches wide. Even though blooms from $5\frac{1}{2}$ to 6 inches are not uncommon, most that I observe are less than $5\frac{1}{2}$ inches wide. The flowers can have very narrow tepals, *i.e.*, be spidery or the tepals can be very wide and overlapping. In the cases where I have recorded the number of blooms per bulb per bloom season of plants under cultivation, it varies from one to five blooms per bulb per season.

The Atamasco rainlily has white flowers with a light yellow-green throat, white filaments and styles, light-yellow anthers, and yellow pollen. The flowers turn pink as they age due to the dying of the cells. This phenomenon is much more prevalent during cool or cold weather and is little seen during warm weather. Independent of this process, some strains and clones of the Atamasco rainlily will have a pink or red tint in their bud stage or show reddish or pink streaks on their buds. Some of this coloration may be carried over to the newly open flowers.

Fellers (1996) points out that all strains of *Z. atamasca* hold their flowers longer than other rainlilies species. He reports flowers in the greenhouse lasting 10 days as being common and some remaining in flower 12-15 days. I grow almost all of my rainlilies in pots and they remain unprotected during the winter; however, I have found that Atamasco lilies normally hold their blooms from 5 to 7 days, depending on weather conditions. It appears that during cool weather the blooms of all species of rainlilies will last longer than during hot weather. For many other species of rainlilies, the bloom will last only one or two days depending on weather conditions. Considering that *Z. atamasca* may hold its bloom 5 days or longer and produce up to 5 blooms per season, it is possible for a single bulb of *Z. atamasca* to provide in excess of 25 bloom days per season. Undoubtedly, *Z. atamasca* can be extremely floriferous under favorable conditions.

Bloom Phenology

I normally keep notes on plants of interest that I observe while traveling on roadways. In 2003 I formalized my roadside observations somewhat by designating observation locations and establishing bloom abundance cate-



Fig. 3. Two *Zephyranthes atamasca* blooms from along roadside, St. Marks, Florida.



Fig. 4. A *Zephyranthes atamasca* bloom from roadside along US highway 98, Wakulla County, Florida.

THE ATAMASCO AND SIMPSON RAINLILIES



Fig. 5. *Zephyranthes atamasca* blooms from along roadside, Wakulla County, Florida.



Fig. 6. *Zephyranthes atamasca* blooming in a field, Wakulla County, Florida.



Fig. 7. A typical *Zephyranthes atamasca* roadside display, US Highway 98, Jefferson County, Florida.

gories. Locations are designated considering the routes I normally travel and available demarcation landmarks. Observations are made whenever I travel by vehicle through these locations for whatever reason and when visibility is not impaired by lack of light, fog, rain, etc. Bloom abundance is recorded as occurring in one of the following four categories: (1) None (N) – No blooms are observed while traveling through a location at a reasonable speed, (2) Few (F) – Blooms are observed and it is possible to count their number, (3) Lots (L) – The observed blooms are too numerous to count, (4) Covered (C) – Areas of suitable habitat are covered with blooms, *i.e.*, the surface areas of suitable habitat are almost literally obscured by blooms. Obviously, any sampling scheme such as this is not random, will be noisy, and some blooms will certainly be missed. And, the demarcation between “Lots” of blooms and being “Covered” with blooms is somewhat arbitrary; however, since the same observer always makes this distinction, I believe it is relatively consistent. Also, the observation locations are of different lengths; however, the number of blooms observed is probably more a function of the amount of suitable habitat present than the length of an observation location.

In order to gain insight into *Z. atamasca* bloom phenology, I selected for analysis all observation locations where I had observed Atamasco rainlily blooms on five or more separate occasions from 2003 through 2007. Seventeen roadside observation locations met this criterion and these are described in Table 3. *Z. atamasca* blooms were observed at the roadside locations at least once every month of the year during the five observation years (Table 4). March and April were clearly the peak bloom period every year and by every measure. The percent of time blooms were observed at observation locations ranged from 64 percent in March of 2007 to 97 percent in March of 2003. And, these were the only months of the year where blooms were observed in the C category. The least number of Atamasco blooms were observed during the months of July through October. There was a fair amount of variability in the abundance of blooms between years and within years undoubtedly reflecting the interactions of temperature, soil moisture, and carbohydrate reserves in the bulbs.

According to Fellers (1996), flowers can be expected in the Atamasco rainlily's northern range about April 15, just after the dogwoods (*Cornus florida*) bloom and in Central Florida about March 15 concurrent with azaleas. He also refers to a unique cold-weather strain near Tallahassee, Florida which flowers in early February; his observation of blooms in February is not inconsistent with what I have observed (Table 4).

Soil moisture also appears to be a major determinate affecting the blooming sequence. Drought conditions existed during the three bloom years prior to the year 2003, when we had a great abundance of rain during late winter and spring. I observed *Z. atamasca* blooming all four years along the roadways in the lower more-wet sites. However, during the spring of 2003, I observed some relatively large patches of *Z. atamasca* blooms along the shoulders of roadways at sites normally relatively dry. Some of these areas I traveled at least several times a week and prior to that year I was not aware that *Z. atamasca* occurred on these sites. If they had been blooming at these sites, I am positive I would have observed them. Evidently, colonies of the Atamasco rainlily can forgo blooming several years in a row and resume blooming when conditions are to their liking. I also noticed that the bloom sequence of these rainlilies did not last as long as colonies in the wetter sites, *i.e.*, they did most of their blooming later in the year. I also observed one rather-open, low-grassy moist area where a rather large colony of the Atamasco rainlily normally blooms every year in sequence with other colonies of rainlilies. During most of March and early

April of 2003, the whole area was flooded with approximately 2 to 6 inches of water and the colony did not initiate blooming until the water had receded, almost a month after others colonies were in full bloom.

Growth Cycle

According to Fellers (1996): (1) Atamasco leaves begin to appear near the end of December in some of the northern range strains, (2) appear in late December in east Central Alabama strains, and (3) appear in September in south Central Georgia strains. Generally, I observe leaf growth begin initiating in late September and October and usually by the end of October the leaves are well developed and are at or approaching their full size and complement. For example, observations made on October 22, 2000 on twenty pots of Atamasco lilies revealed that: (1) plants originating in Florida in five pots were developing leaves, (2) plants originating in Florida in twelve pots had a full complement of leaves and the leaves were approaching or were of full size and maturity, and (3) plants in only three pots had no leaf growth, and two of these pots contained plants originating from outside of Florida in more northern areas. Generally, the plants retained their leaves throughout the winter until after the blooming season; however, they may lose their leaves during very extreme cold spells and then regrow them when conditions became favorable. Most clones lose their leaves after flowering and the ripening of their seeds; however, a few clones will retain some leaves during some summers as long as conditions are not too dry and hot.

Asexual Reproduction

Many have commented on the Atamasco rainlily reproducing by basal offsetting, *e.g.* Meerow (1985) talks about the clumping habit of *Z. atamasca* contrasted with the “usually solitary nature” of *Z. treatiae*. However, I have seen very little mention of the fact that some clones are stoloniferous, *i.e.*, reproduce by droppers. I first noticed this when examining a three-gallon nursery pot previously planted with a single narrow-leafed Atamasco. The pot had many rainlilies growing in a random pattern as if one had randomly scattered seeds over the surface of the pot and no two plants were close together as seen when basal offsetting occurs. Upon emptying the pot it was obvious that the mother bulb was reproducing additional bulbs at the ends of 2- to 6-inch long stolons. If this bulb had been observed growing in the wild and was not carefully dug up, it would have been very easy to conclude that it was not reproducing asexually. This trait seems to be more prevalent

in narrow-leaved clones, and I originally thought this might be a way to distinguish between narrow-leaved and wide-leaved Atamasco rainlilies. However, subsequently I found some wide-leaved stoloniferous clones. It suffices to say that some clones will reproduce only by basal offsetting, some only by stolons, and some by a combination of the two. I assume genetics is playing some role in this process; environmental conditions may also be playing an important role.

As Fellers (1996) has pointed out, and I have observed, the Atamasco bulbs never go completely dormant, and they continue growing and reproducing asexually underground throughout the year. Meerow (1985) believes that the clumping habit of *Z. atamasca* contrasted to the solitary habit of *Z. treatiae* may be an artifact of habitat differences. I believe that its solitary reputation is in some part due to the difficulty of recognizing in the field that some clones are asexually reproducing with stolons.

Sexual Reproduction and Hybridization

Pollination and production of Atamasco seed is similar to other rainlilies. Fellers (1996) points out that seeds are often slow to germinate, and he recommends that at least two years go by before pots with sown seeds are discarded. He also states that Atamasco seedlings often take longer than other rainlilies to reach first blooming, and that it may take 4 or 5 years or even longer.

There is little information in the literature on the somatic makeup of the Atamasco rainlily; Howard (2001), Meerow (1985), and Flagg (1961) gives chromosome numbers for both *Z. atamasca* and *Z. treatiae* of $2n = 24$. *Z. atamasca* can serve both as a pod and a pollen parent; however, some clones are much more susceptible to cross pollination than others. Fellers (1996), using *Z. atamasca* as the pod parent, has successfully crossed it with *Z. grandiflora*, *Z. 'Horsetail Falls'*, *Z. katherinae* (*Z. katherinae rosea*), and various unnamed hybrid rainlilies. Using *Z. atamasca* as the pollen parent he successfully crossed it with various unnamed hybrid rainlilies. Forbes (1975) discusses *Z. atamasca* hybrids made by Flagg between *Z. atamasca* x *Z. sp. K484* (from San Luis Potosi Mexico-Hayward) and given the grex name *flaggii* by Alex Korsakoff. Forbes states that Korsakoff named individuals from this cross Betsy, Cathy, and Rick for the Flagg children, and that he later repeated this cross with good results. [Korsakoff's *Z. x flaggii* hybrids discussed by Forbes are not the same as the *Z. x flaggii* hybrid described by Spencer (1986).]

I have made a few crosses using *Z. atamasca* as the pod parent. So far none of these has amounted to much. One offspring, with *Z. drummondii* as the pollen parent, appears to be confused as to what parent it wants to favor. It can't make up its mind if it wants to be a summer grower or a winter grower. For several years it will grow actively through the hottest part of the summer and be dormant during the winter, and then it will reverse itself and for several years actively grow throughout the winter and be dormant during the summer. It will then repeat this pattern. So far it has not bloomed, but hope rests eternal with gardeners.

THE SIMPSON RAINLILY

Zephyranthes simpsonii is a delightful small rainlily that can be easily distinguished from *Z. atamasca* by observing the length of the stamens and styles and the trumpet-like appearance of the flowers. The stamens and styles of the Simpson rainlily are always equal in length to or are shorter than the anthers while the stamens and styles of the Atamasco rainlily always exceed the anthers.

The range of the Simpson rainlily is usually given (*e.g.* Hume, 1935) as being restricted to Central Florida approximately south of a line drawn between Gainesville and Cedar Keys, Florida. Fellers (1996) points out that "some herbarium specimens indicate that they have been collected further north; however, the date on these specimens predated several freezes that wiped out the citrus to the vicinity of McIntosh, Florida", and he considers it a tender species. I have been growing *Z. simpsonii* in pots in my garden, and these plants have overwintered successfully without problems for a number of years in Wakulla County.

According to Landon (1983), *Z. simpsonii* occurs as isolated colonies from Florida Alachua County south to Hendry and Lee Counties. Landon also states that a few bulbs planted around 20 years in northwest Gainesville Florida in an area of high, well-drained, sandy soil have survived and multiplied to some extent in a mowed area of mainly centipede grass. This area is seldom mowed between October and May but is mowed frequently during the summer. Hume (1935) states *Z. simpsonii* extends southward in Florida to Lee County on the Gulf of Mexico and into Martin County on the Atlantic Ocean. Wunderlin and Hansen (2003) state, based on vouchered herbaria specimens, that *Z. simpsonii* occurs in the following Florida counties: Brevard, Charlotte, Collier, De Soto, Glades, Hardee, Hernando, Hillsborough, Lee, Levy, Manatee, Marion, Martin, Okeechobee,

Orange, Osceola, Palm Beach, Pinellas, Polk, and Volusia.

Plant Delights Nursery, Inc. @ Juniper Level Botanic Gardens has been offering a “new” rainlily from the coastal Brunswick County, North Carolina which they say experts are leaning toward being a disjunct population of *Z. simpsonii*. I grow some of their rainlilies, and they appear to be very morphologically similar to the *Z. simpsonii* that I grow originating from Florida. Flagg, Smith & Flory (2002) list it as occurring in Alabama, Florida, Georgia, Mississippi, North Carolina and South Carolina. According to Spencer (1973) *Z. simpsonii* “...has been collected in Mississippi and South Carolina, probably having been carried to those areas in road ballast.” I assume that populations of *Z. simpsonii* outside of Florida are introductions or escapes from cultivation.

Most Simpson rainlily strains have considerably more pink or red coloring in their flowers than the Atamasco rainlily. The flowers are normally much smaller than the Atamasco rainlily with widths usually in the neighborhood of 1 to 1½ inches. The perianth segments spread only near the apex giving the flowers a trumpet-like look. I have observed *Z. simpsonii* blooming from April through July in both the wild and under cultivation. Some strains will have highly ruffled tepals. The flowers are lovely; but should be viewed from up close to be fully appreciated.

Also, as for the Atamasco rainlily, there is little information in the literature on the somatic makeup of the Simpson rainlily; Howard (2001), Flagg (1961), and Meerow (1985) give $2n = 48$ as compared to $2n = 24$ for the Atamasco rainlily. Usually it is stated that *Z. simpsonii* is closely related to *Z. atamasca*, and according to Meerow (1985) it “may well be a tetraploid derivative of *Z. atamasca* var. *treatiae*.” It would be interesting to see if DNA/hybridization studies would bear this out; to me *Z. simpsonii* appears to be a very different plant. The flowering and growth habits are quite different. The bulbs are very different in appearance than the Atamasco rainlily. The globular black bulbs, up to 1½ inches in diameter, are larger than the light colored Atamasco bulbs, less than 1 inch in diameter. The Simpson bulbs are usually found at depths of 5 to 6 inches. If derived solely from *Z. atamasca* it would be an autopolyploid, and as Grant (1981) points out, it is usually supposed that an autopolyploid will resemble its diploid ancestors, but this is not always true. If it arose sympatrically, it would face the challenge of competition with its more abundant ancestors and/or being “mated to death” (Coyne & Orr, 2004) until isolation mechanisms developed. One could wonder if *Z. simpsonii* might not be an amphiploid

(allopolyploid) arising from *Z. atamasca* hybridizing with some formerly present species of more tropical origin.

According to Fellers (1996), *Z. simpsonii* will cross with other rainlilies, and he discusses a *Z. simpsonii* x *Z.* 'Horsetail Falls' cross. Wilson (1977) discusses Alex Korsakoff use of *Z. simpsonii* as both a seed and pollen parent. She describes Korsakoff's *Z. clintiae* x *Z. simpsonii* cross as an astonishingly beautiful large flower with peppermint strips of dark rose and rose red. I have been negligent in not attempting to cross the Simpson rainlily as it seems to have many desirable traits worth passing on to its offspring, not the least being the ruffling of the tepals.

Fellers (1996) states that *Z. simpsonii* is a temperamental rainlily that "does not respond well after being disturbed or moved even when moved in a large clod of soil." I have found the opposite to be true, and I wonder if there might be a difference in strains or in the time of year transplanting was attempted.

DISCUSSION

The native Atamasco rainlily occurs over a wide geographical area and in a variety of habitats, and there is considerable variation in its leaves, flowers, growth cycle, and adaptability. Both the Atamasco and Simpson rainlilies are excellent garden and landscape plants, well adapted to the warm humid climates of the southern United States. They deserve a more prominent place in our gardens and natural areas and much more attention in our horticulture community.

TABLE 1. Some distinguishing characteristics of *Zephyranthes atamasca*, and *Z. treatiae* taken from the literature.

SPECIES	SOURCE	CHARACTERISTICS
<i>Z. atamasca</i>	Wunderlin (1998)	Flower: Style and stigma exceeding the anthers. Perianth segments spreading at anthesis. Perianth tube usually less than 2.3 cm long and less than 1/4 the length of the perianth. Filaments at least 1.5 times the perianth tube length. Leaves: Mature leaves 3-8 mm wide. Habitat: Moist flatwoods.
	Clewell (1985)	Leaves: 2.5-4.5 mm wide, flat when dry and concave when fresh. Habitat: River swamps, bluffs, limestone outcrops, roadsides.
	Fellers (1996)	Leaves: 2-7 mm wide. Habitat: Floodplains, stream overflow areas, highlands, ridges, fields, roadbeds, pinewoods, deciduous hardwood forests, full sun, shaded sites, heavy clay, muck soils, and sandy soils. Remarks: Fellers gives detail information on ten different strains of <i>Z. atamasca</i> , relative to leaves, flowers, and other characteristics, as well as their ecology. The reader is referred to his paper. It suffices to say here that they are quite varied and Fellers states that there are more differences in <i>Z. atamasca</i> than in some of the yellow and pink <i>Zephyranthes</i> that are classified as separate species and varieties.
	Hume (1935)	Leaves: Bright shining green, thin along the edges and channeled on the upper surface. Habitat: Swamps, river bottoms subject to overflows and slopes of moist woodlands where vegetable matter and humus from tree debris are abundant. Found were blackgum, sweet gum, swamp chestnut oak, water oak, ash, cypress, red maple and wax myrtle occur.
	Austin (2000)	Leaves: 2.5-4.5 mm wide. Habitat: Mixed forest, clearings, meadows, moist wet pastures.
	Spencer (1973)	Flower: Perianth pure white, 3 in. long; tube 1/2 in/long tinged green; segments oblanceolate-unguiculate, acute, 1/2 in. long. Style trifid, reaching nearly to tip of segments. Leaves: 3-8 mm wide, bright green. Range: Southern United States.
	Flagg, Smith, & Flory (2002)	Flower: Perianth mostly white, sometimes tinged or veined pink; funnelliform; perianth tube less than 1/4 perianth length, and ~1/2 (1/3 -2/3) filament length, and ~ 1/2 (1/3 - 3/4) spathe length. Habitat: Rich mixed forests, moist clearings, meadows, moist to wet pastures, coastal plains, piedmonts. Leaves: To 8 mm wide, shiny green. Range: Alabama, Georgia, Maryland, Mississippi, North Carolina, South Carolina, & Virginia.
<i>Z. treatiae</i>	Wunderlin (1998)	Flower: Style and stigma exceeding the anthers. Perianth segments spreading at anthesis. Perianth tube usually exceeding 2.3 cm long and more than 1/4 length of the perianth. Filaments not more than 1.5 times the perianth tube length. Leaves: Mature leaves 2-4 mm wide. Habitat: Moist hammocks and floodplains.
	Clewell (1985)	Leaves: 1-2 mm wide; somewhat wrinkled when dry and sulcate when fresh. Habitat: Flatwoods and roadsides.
	Fellers (1996)	Leaves: 2.0-2.5 mm wide and yellowish green. Range: Range limited area between Jacksonville, Florida and the Okefenokee Swamp.
	Hume (1935)	Leaves: Narrow, thick shorter, and a different shade of green than <i>Z. atamasca</i> . Habitat: Flatwoods, with pines, saw palmetto, gall berry, and wax myrtle and in high hammocks with live oaks, ironweed, sweet gum, and red cedar and in low hammock along streams.
	Austin (2000)	Leaves: 1-2 mm wide. Habitat: Wet pine flatwoods, roadsides and mowed sod near flatwoods.
	Spencer (1973)	Flower: Perianth white becoming pink as mature; tube 2.54 cm long, segment curved outward and downward, stigma deeply trifid, well above anthers. Leaves: 3 mm wide, dull gray green. Range: Southern Carolina to Florida, including Georgia Alabama & Mississippi.
	Flagg, Smith, & Flory (2002)	Flower: Perianth mostly white to pink, perianth tube +/- equaling (2/3 - 11/4) filament length and ~2/3 - 11/3 spathe length. Leaves: To 4 mm wide, dull green. Habitat: wet inland or former pineland sites. Range: Florida and Georgia. Remarks: They state that: "the greater length of the perianth tube compared with that of the filaments in <i>Z. treatiae</i> readily separates that species from <i>Z. atamasca</i> ."

TABLE 2. Some distinguishing characteristics of *Zephyranthes simpsonii* taken from the literature.

SOURCE	CHARACTERISTICS
Wunderlin (1998)	Flower: Perianth segments erect and spreading only near the apex at anthesis. Style and stigma equaling or shorter than the anthers. Habitat: Wet flatwoods and meadows.
Fellers (1996)	Leaves: 3 mm wide.
Hume (1935)	Flowers: Sepals and petals upright slightly bend outward at the tips or not at all. Flower presents the appearance of a trumpet. Sepals washed or marked with pink more strongly than <i>Z. atamasca</i> or <i>Z. treatiae</i> . A polymorphic species but the relative length of the stamens and styles is always a very constant feature. Leaves: Dull gray green with thickened edges and narrower than <i>Z. atamasca</i> .
Austin (2000)	Leaves: 1-1.5 mm wide. Habitat: Wet pinelands, pastures that were formally pinelands, roadsides.
Landon (1983)	Flowers: 1 per scape often pink to purplish externally, white inside; perianth segments oblanceolate erect to slightly spreading with erect filaments. Leaves: About 2 mm wide, glabrous, elongate-linear, fleshy, rounded on back, edges rounded and smooth. Habitat: Low pine flatwoods and savannas and at margins of wet hammocks and pastures developed from such areas to moist mowed roadsides. Usually occurs and grows best in wet or moist soil. However, it grows reasonably well and multiplies on well-drained sandy soils if competition is adequately controlled. Range: Florida Alachua County south to Hendry & Lee Counties.
Spencer (1973)	Flower: Perianth white, often slightly flushed with pink, funnelliform; stigma trifid, stamen and style equal, included. Leaves: 2-4 mm wide. Range: More or less restricted to peninsular Florida in United States, especially area south of Bradenton; has been collected in Mississippi and South Carolina, probably carried there in road ballast.
Flagg, Smith, & Flory (2002)	Flower: Perianth mostly white often strongly infused pink or purple distally; perianth tube $\sim 1/3$ or more perianth length, +/-equaling or seldom less than $(3/4 - 1 1/4)$ filament length, style longer than perianth tube, stigma 3-fid, usually among or below anthers, rarely exerted more than 1 mm beyond anther. Leaves: To 4 mm wide, dull green. Habitat: Peaty-sandy soil, coastal plains, rarely piedmont. Range: Alabama, Florida, Georgia, Mississippi, North Carolina, & South Carolina.

THE ATAMASCO AND SIMPSON RAINLILIES

TABLE 3. Descriptions of roadside locations in Florida where *Zephyranthes atamasca* bloom observations were analyzed.

LOCATION NO.	DESCRIPTION	LENGTH ~MILES
1.1	Fl Highway 363 in Wakulla County from junction of US Highway 98 north to Kinsey Drive	1
1.2	Fl Highway 363 in Wakulla County from junction of Kinsey Drive north to Fl Highway 267 (Wakulla Station).	2
1.3	Fl Highway 363 in Wakulla and Leon Counties from junction of Fl Highway 267 (Wakulla Station) north to town of Woodville.	6
1.5	Fl Highway 363 in Wakulla County from junction of US Highway 98 south to town of St. Marks.	2
1.6	Kinsey Drive in Wakulla County from Buck Forest Subdivision east to Highway 363.	0.5
2.1	Roadways in the town of St. Marks in Fl Wakulla County.	5
3.1	US Highway 98 in Wakulla County from junction of Fl Highway 363 east to town of Newport and St. Marks River.	2
3.2	US Highway 98 in Wakulla County from town of Newport and St. Marks River east to Jefferson County boundary.	6
3.3	US Highway 98 in Jefferson County from boundary with Wakulla County east to Fl Highway 59.	1
3.4	US Highway 98 in Jefferson County from junction with Fl Highway 59 east to Aucilla River and Fl Taylor County	6
3.5	US Highway 98 in Taylor County from junction with Aucilla River east to junction with Econfinia River.	6
3.6	US Highway 98 in Taylor County from junction with Econfinia River east to town of Perry.	17
4.1	US Highway 98 in Wakulla County from junction with Fl Highway 363 west to Wakulla River and Lower Bridge Road.	2
4.2	US Highway 98 in Wakulla County from junction with Wakulla River and Lower Bridge Road west to FL 365 Highway (Spring Creek Highway).	5
4.3	US Highway 98 in Wakulla County from junction with Fl 365 west to Reywinkle Road.	2
7.1	Fl Highway 267 in Wakulla County from junction with Fl Highway 363 west to Fl Highway 61.	5
7.5	Fl Highway 267 in Wakulla County from junction with Fl Highway 363 east to US Highway 98.	4

TABLE 4. Number of times *Zephyranthes atamasca* blooms were observed at roadside observation locations during a given time period. Bloom abundance categories were coded as follows: N = None, F = Few, L = Lots, C = Covered and % O = Percent of time blooms were observed at the roadside observation locations. See text for a fuller description of the abundance categories. Descriptions of the roadside observation locations are given in Table 3 and are discussed in the text.

MONTH & ABUNDANCE		YEAR				
		2003	2004	2005	2006	2007
Jan.	N	--	116	90	94	67
	F	--	1	19	23	19
	L	--	--	1	--	--
	C	--	--	--	--	--
	% O	--	1	18	20	22
Feb.	N	--	114	67	68	82
	F	--	7	28	29	9
	L	--	--	2	4	--
	C	--	--	--	--	--
	% O	--	6	31	33	10
March	N	2	52	35	14	31
	F	15	47	32	38	27
	L	38	34	27	42	24
	C	8	23	10	15	4
	% O	97	67	66	87	64
April	N	38	35	23	24	12
	F	51	39	16	22	9
	L	20	21	49	30	23
	C	3	19	13	8	7
	% O	66	69	77	71	76
May	N	74	59	55	77	68
	F	16	12	28	26	9
	L	--	--	3	--	--
	C	--	--	--	--	--
	% O	18	17	36	25	12
June	N	19	83	103	62	49
	F	--	14	10	--	20
	L	--	--	--	--	--
	C	--	--	--	--	--
	% O	0	14	9	2	29
July	N	11	110	88	88	90
	F	1	--	5	2	8
	L	--	--	--	--	--
	C	--	--	--	--	--
	% O	8	0	5	2	8
Aug.	N	--	94	122	27	110
	F	--	2	--	2	3
	L	--	--	--	--	--
	C	--	--	--	--	--
	% O	--	2	0	7	3
Sept.	N	--	186	116	60	98
	F	--	--	1	1	3
	L	--	--	--	--	--
	C	--	--	--	--	--
	% O	--	0	1	2	3
Oct.	N	--	99	61	84	82
	F	--	15	4	15	1
	L	--	--	--	--	--
	C	--	--	--	--	--
	% O	--	13	6	15	1
Nov.	N	57	99	58	66	62
	F	44	29	15	30	4
	L	--	--	--	--	--
	C	--	--	--	--	--
	% O	44	23	21	31	6
Dec.	N	106	84	77	53	81
	F	4	22	11	67	16
	L	--	--	--	--	--
	C	--	--	--	--	--
	% O	4	21	13	56	16

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Editor's Note:

1) There is confusion regarding the proper taxonomic epithet for the Atamasco rainlily. Linnaeus (p. 292, 1753) originally published it as *Amaryllis atamasca* in Species Plantarum I. However, he contributed to the confusion in Species Plantarum II (p. 420, 1762) by listing it as *Amaryllis atamasco*. When Herbert (p.36, 1821) reclassified it under *Zephyranthes* (Occidental Swamp-Lily) in An Appendix, he wrote it as *Zephyranthes atamasco*. So today it can be found in the literature spelled either as *Z. atamasca* or *Z. atamasco*. In botanical Latin a noun ending in 'es' is a Third Declension, neuter noun, and it would seem that "atamasco" would be the proper epithet. However, "Zephyranthes" is Greek in origin, the gender being a little obscure, but a suffix ending in -anthe is generally regarded as being feminine gender; hence "atamasca" would seem appropriate. So what is the correct answer? Well, the issue has been addressed by the International Association for Plant Taxonomy (International Botanical Congress) through its publication: International Code of Botanical Nomenclature. Listed below is verbatim from the 2005 Vienna Code:

Appendix III Nomina generica conservanda et rejicienda.

<i>Zephyranthes</i> Herb., Appendix: 36. Dec 1821 [<i>Amaryllid.</i>]. Typus: <i>Z. atamasca</i> (L.) Herb. (<i>Amaryllis atamasca</i> L.) (typ. cons.).	(≡)	<i>Atamosco</i> Adans., Fam. Pl. 2: 57, 522. Jul-Aug 1763.
--	-------	--

The answer is very clear and cannot be debated: *Zephyranthes atamasca*.

2) Confusion also abounds over the proper epithet-spelling for *Z. katherinae* L.B. Spencer (1986). Unfortunately Spencer (1973) initially listed it as *Z. katherinei* in her PhD thesis, but the latter did not qualify as a valid publication for a new species. Another common erroneous spelling is *Z. katherinae*.

3) This manuscript was received for publication on September 23, 2008, and the revised form accepted for publication on November 13, 2008. Under the author's discussion of *Z. treatiae*, he alludes to a pending *Zephyranthes* publication by R. Flagg and G. Smith; the latter will appear in *Castanea* 73(3), September, 2008.

***CRINUM HANITRAE*, SP. NOV (AMARYLLIDACEAE) FROM
EXTREME NORTH MADAGASCAR**

David J. Lehmiller
18173 Hwy 326 North
Sour Lake, TX 77659 USA
E-mail: drcrinum@aol.com

Alvin L. Sisk
P.O. Box 68
Lexington, TX 78947 USA
E-mail: al@alsisk.com

INTRODUCTION

Olaf Pronk, a Dutchman, operates a large indigenous plant nursery in Antananarivo, Madagascar. Many of the plants offered through his establishment have originated via the collecting efforts of his trusted Dutch employee, Nero; other native plant collectors have also contributed to his stock. Nero often makes treks by himself into remote regions of Madagascar for weeks at a stretch, sometimes only on foot.

In December, 2005, Nero collected a very unusual *Crinum* east of

Ramena at the Baie de Sakalava in extreme North Madagascar. He discovered the bulbs growing in sand dunes very close to the Indian Ocean, in full sun exposure, and he noted that the outer leaves were prostrate upon the ground. Only one bulb was flowering, but he did not describe the flower. When Pronk received these bulbs in Antananarivo, he was impressed by the extremely broad but short leaves, and he photographed one bulb that was huge (Fig. 1), having leaves almost 15 cm wide.

Flowering size bulbs were obtained in 2007 by the authors via Out of Africa, an importing company in the United States contracted with Pronk; none of these bulbs though approached the size



Fig. 1. Giant bulb of *Crinum hanitrae*, originally collected at the type locality in extreme North Madagascar, January 5, 2006. (Photograph courtesy of Olaf Pronk.)

CRINUM HANITRAE, SP. NOV (AMARYLLIDACEAE) FROM EXTREME NORTH MADAGASCAR



Fig. 2. Bulb shape of *Crinum hanitrae*, May 24, 2008. (Photograph by A. Sisk)



Fig. 3. Mature leaf pattern of *Crinum hanitrae*, June 11, 2008. (Photograph by D. Lehmillier)



Fig. 4. *Crinum hanitrae* in bud, June 21, 2007.
(Photograph by A. Sisk)

on the huge bulb demonstrated in Figure 1. Bulbs were cultivated in well draining, sandy soil in the ground and in plastic pots (ALS) and in clay pots (DJL). It was determined after flowering and fruit formation that this *Crinum* was an undescribed species (Fig. 2-7). This information was communicated to Pronk, who requested that the new species be named in honor of his daughter, Mrs. Randrianantoandra Hanitriniaina Laurette ("Hanitra"), who was also a plant enthusiast.

Crinum hanitrae Lehmiller & Sisk, sp. nov.

Speciem ceteram abhorrens a foliis latis brevissimis.

Type: Madagascar. Baie de Sakalave, east of Ramena, extreme north Madagascar. Bulb originally collected December, 2006, and subsequently cultivated in Texas, June, 2008. Lehmiller & Sisk 1952, TAMU.

DESCRIPTION

Bulb a somewhat flattened globe covered with a tan-brown papery tunic, 8.3-8.8 cm diameter by 6.5-7.0 cm tall, with a short underground neck 2.5-5.5 cm long, with white roots. Leaves 7-10, distinctly short and broad, forming a rosette without a false stem, low arching and often hugging the ground in older leaves, broadly lanceolate, tapering to a blunt acute tip, newer leaves with intact apices, sometimes weakly undulant, broadly channeled in newer leaves with older leaves eventually flattening, with midline thickening but lacking a distinct depressed midrib effect, with parallel longitudinal nerves on the ventral surface, containing tiny wooly fibers visible when torn, margins entire, green, 19-24.5+ cm long by 7.2-9.8+ cm wide. Scape arising between the lower leaves and displaced laterally by newer leaves, ovoid, light green, 28-38 cm long. Spathe composed of two external bracts, persisting in earlier phases of flowering but slowly spreading and beginning to wither as late flowers begin to bloom, light green with some reddish streaks, 5.5-6.5 cm long by 1.5-1.8 cm wide. Umbel 3-9, with a few small internal filamentous bracts, flowers zygomorphic and appearing star-shaped with a somewhat flattened face, sessile, opening at night, lightly and pleasantly scented.

CRINUM HANITRAE, SP. NOV (AMARYLLIDACEAE) FROM EXTREME NORTH MADAGASCAR



Fig. 5. *Crinum hanitrae* in flower, May 24, 2008. Note the short filaments and non-emergent style. (Photograph by D. Lehmler)

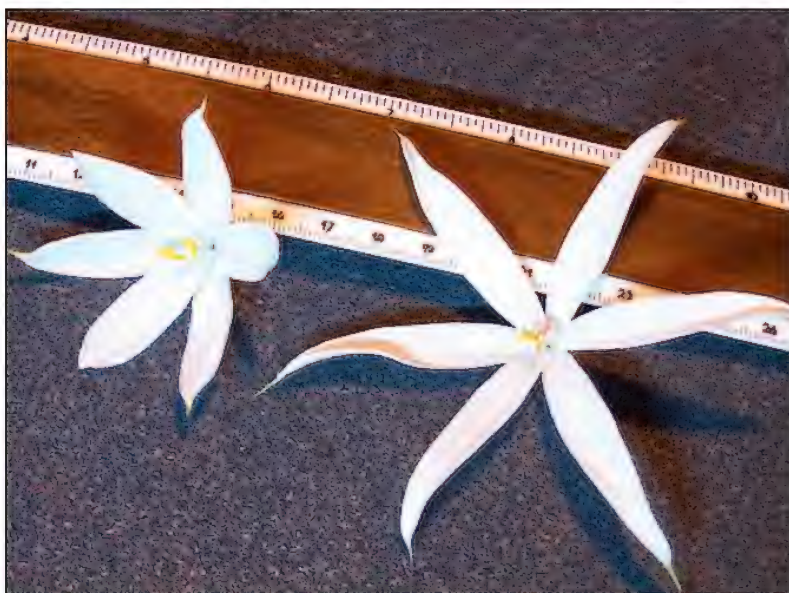


Fig. 6. Variation in segment length in *Crinum hanitrae*, June 4, 2008. (Photograph by A. Sisk)

Buds pointed and becoming somewhat rotund near anthesis, initially erect, and then moving outward to become vertically drooped prior to arising to a suberect to near erect position at anthesis, cream colored with a slight greenish hue distally. Perianth tube mildly curved distally or nearly straight at anthesis, pale green but nearly becoming whitish near the distal end, 6.5 cm long. Segments lanceolate, white, slightly recurved near the distal tips, with small greenish apiculates more pronounced on the outer segments, inner segments slightly shorter and broader than the outer segments, 4.0-5.7 cm long by 0.8-1.3 cm wide. Filaments very short, white proximally and pink distally, those attached to the inner segments slightly longer than those attached to the outer segments, 0.7-1.5 cm long. Style non-emergent, with stigma circa 1.0 cm from the throat opening of the flower, purplish pink; stigma tiny capitate; no nectar visible in the throat of the flower. Ovary dark green, 5 mm long by 4 mm in diameter. Fruit globular to trilobular, usually with a short apical rostellum 0.5-2.7 cm long, greenish with some dull reddish streaking, but colors fading to tan near maturity, indehiscent, 1.8 x 2.4 x 2.4 cm to 2.2 x 2.5 x 3.3 cm in dimensions. Seeds 1-3 per fruit, smooth with a few shallow crevices on the surface, light dull gray to grayish green, 1.0-2.2 cm in diameter. (Fig. 8, 9)

Habitat: Occurring in sand dunes very close to the ocean, in far north Madagascar.

DISCUSSION

The broad-short leaves of *Crinum hanitrae* are quite unlike any other Malagasy *Crinum*, a characteristic that should make recognition in the field and in herbaria straight forward. Owing to the fact that the type locality region is sparsely populated and lacks a decent road system probably accounts for its absence in botanical literature. A second site was recently discovered by Giuseppe Orlando northwest of Vohémar along the road to Daraina in far Northeast Madagascar (Fig. 10).

Crinum hanitrae becomes the fourth Malagasy species to be described that possesses the unusual floral features of zygomorphic shaped flowers with very short filaments and non-emergent (or minimally emergent) styles. It is as though both the filaments and the style have undergone a reduction phenomenon in these species. The other Malagasy species falling into this floral category are: *C. filifolium* H. Perrier (1939), *C. modestum* Baker (1887), and *C. mccoysi* Lehmillier (2003-04). This floral pattern devi-

CRINUM HANITRAE, SP. NOV (AMARYLLIDACEAE) FROM EXTREME NORTH MADAGASCAR



Fig. 7. *Crinum hanitrae* in fruit, June 30, 2008. (Photograph by A. Sisk)



Fig. 8. Type specimen of *Crinum hanitrae*, Lehmillier & Sisk 1952, June 2008.

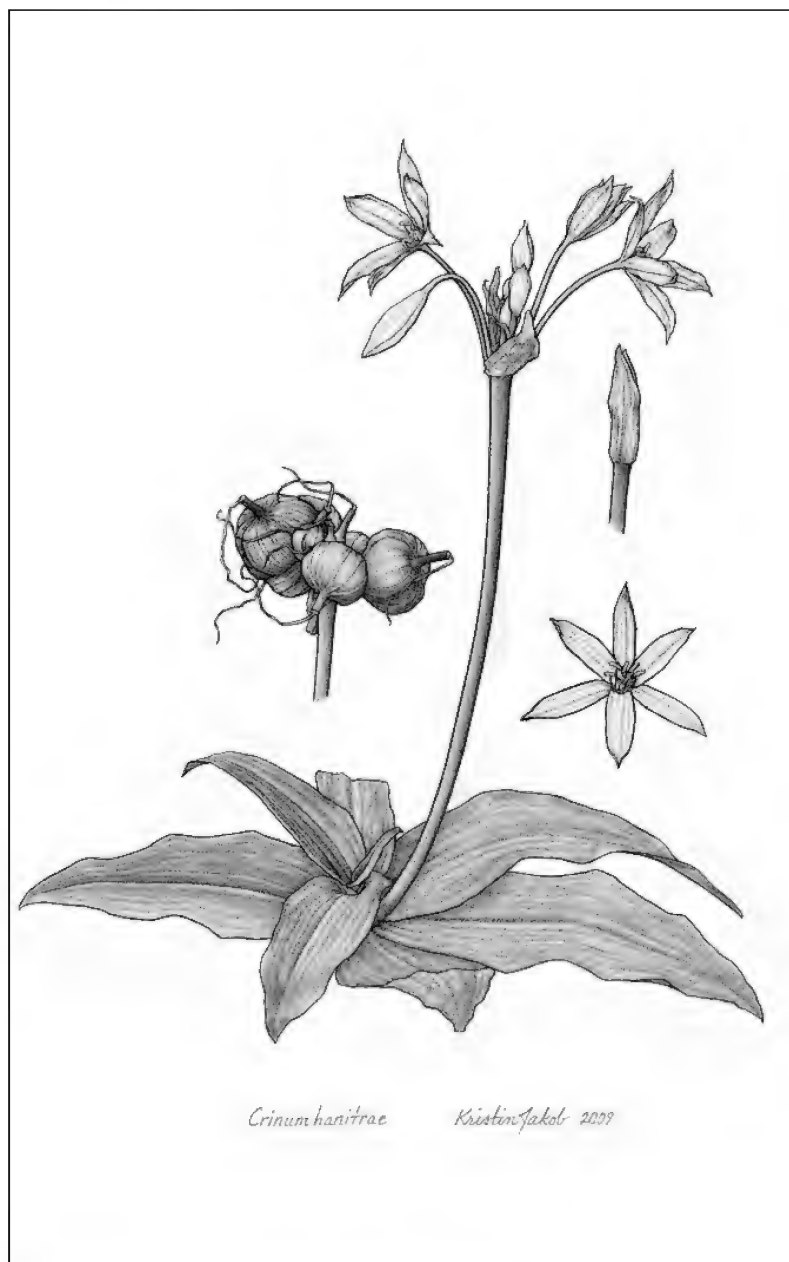


Fig. 9. Illustration of *Crinum hanitrae* Lehmiller & Sisk by Kristin Jakob.

CRINUM HANITRAE, SP. NOV (AMARYLLIDACEAE) FROM EXTREME NORTH MADAGASCAR

ates substantially from the criteria for Subgenus *Codonocrinum* and probably deserves separate classification. There are also two other, non Malagasy species with the same floral pattern, *C. brachynema* Herbert (1842) of India and *C. venosum* R. Brown (1810) of Australia.

ACKNOWLEDGEMENTS

Botanical illustrator and IBS member Kristin Jakob of Valley Mills, California is gratefully acknowledged for the illustration of *Crinum hanitrae* Lehmiller & Sisk. Appreciation is extended to IBS member Giuseppe Orlando from the Canary Islands for providing the field photograph of *Crinum hanitrae*.

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Fig. 10. *Crinum hanitrae* with young leaves and developing scapes, approximately 2 weeks after the onset of the rainy season, Northwest of Vohémar along the road to Dariana, December 15, 2008. (Photograph courtesy of Giuseppe Orlando)



HERBERTIA 62 • 2008

WINTER 2008 EXPEDITION TO SOUTHERN MEXICO A THIRTY DAY AND SEVERAL THOUSAND KILOMETER TRIP TO SOUTHERN MEXICO

Guy Wrinkle
Los Angeles, CA USA
E-mail: guy@rareexotics.com

1. SAN LOUIS POTOSI

A quick stop for *Tillandsia tortilis* (Fig. 1) and *Echeveria agavoides* (Fig. 2). The *Tillandsia* is found growing on pine and oak trees, whereas the *Echeveria* is found on more hospitable ground. The photos do not do justice to the amount of variation found in these populations.



Fig. 1. *Tillandsia tortilis*.



Fig. 2. *Echeveria agavoides*.

2. THE STATES OF MORELOS AND MEXICO

Hechtia matudae (Fig. 3) and *Tillandsia susperinsignis* (Fig. 4, 5) are found here on very steep cliffs. The form of *Tillandsia prodigiosa* (Fig. 6) which is found in this area grows epiphytically and is much nicer and easier to grow than the form of this species which grows in Oaxaca. As is true of many places in Mexico, unusual species of orchids are also found here (Fig. 7, 8).

WINTER 2008 EXPEDITION TO SOUTHERN MEXICO

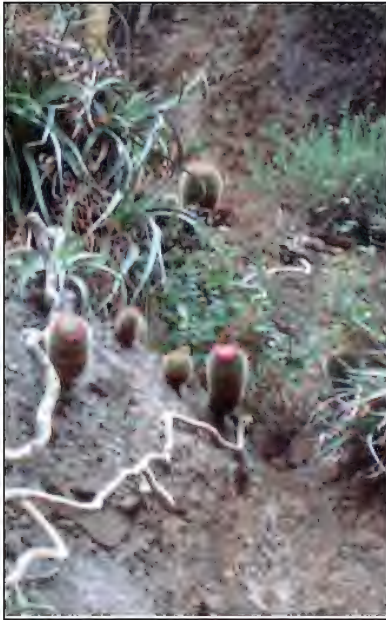


Fig. 3. *Hechtia matudiae*.



Fig. 4. *Tillandsia superinsignis*.



Fig. 5. *Tillandsia superinsignis* in sun.

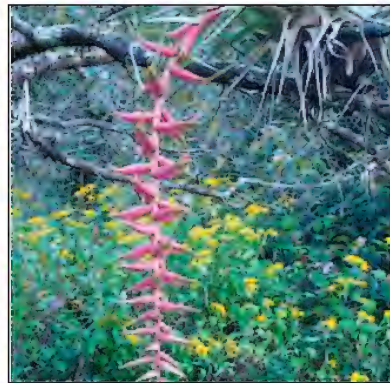


Fig. 6. *Tillandsia prodigiosa*.



Fig. 7. *Oncidium unguiculatum*?



Fig. 8. *Laelia autumnalis* close up.

3. CHIAPAS - WAY DOWN SOUTH

A) In the pine and oak forests, two large species, *Tillandsia eizii* (Fig. 9) and *Tillandsia ponderosa* (Fig. 10) are found along with other species of *Tillandsia*. Unfortunately, these inflorescences are pulled from the plants to be used by the local people for religious purposes – the plant displayed in Fig. 10 is lucky that it has not yet colored up else it would have been harvested by the local people. Who needs flowers when there are leaves like the Mexican form of *Tillandsia guatemalensis* (Fig. 11, 12)?

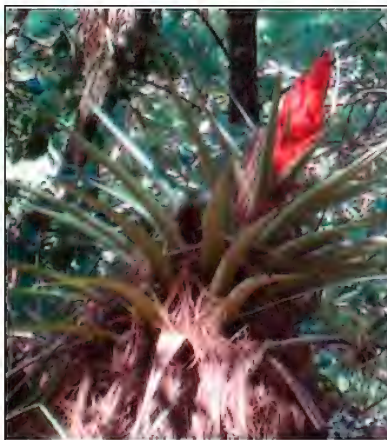


Fig. 9. *Tillandsia ponderosa*.

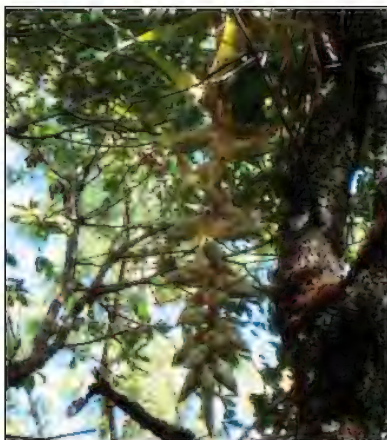


Fig. 10. *Tillandsia eizii*.

WINTER 2008 EXPEDITION TO SOUTHERN MEXICO



Fig. 11. *Tillandsia guatemalensis* (Mexican Form).



Fig. 12. *Tillandsia guatemalensis* leaves (Mexican Form).

B) Dry oak forest with many other species. *Tillandsia ehlersiana* is only found in one small area with very steep cliffs. Many different forms of *Tillandsia fasciculata* are found in this state.

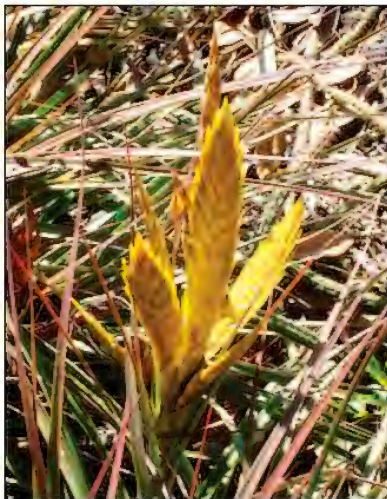


Fig. 13. *Tillandsia buetelspacheri*.



Fig. 14. *Laelia rubescens* semi-alba.

WINTER 2008 EXPEDITION TO SOUTHERN MEXICO

Tillandsia fasciculata (Fig. 15) with tarantula and ants (Fig. 16) which were living inside it !!!!!



Fig. 15. *Tillandsia fasciculata*.



Fig. 16. Tarantula and ants.



Fig. 17. *Tillandsia ehlersiana*.

Tillandsia ehlersiana (Fig. 17) and companions (Fig. 18). The two bulls in the front may not look BIG but they are HUGE. The big one on the left walked right up to me and asked if I had permission to be there. Luckily, I was able to BS him before I escaped to the other side of the fence.



Fig. 18. Bulls.

WINTER 2008 EXPEDITION TO SOUTHERN MEXICO

C) Sumidero Canyon

Do you want
*Tillandsia juerg-
rutschmannii* (Fig.
20)? No problem!
Just climb over the
side. For reference,
the small white streak
in the river is a power
boat (Fig. 19) to pick
you up when you fall.



Fig. 19. Sumidero Canyon.



Fig. 20. *Tillandsia
juerg-rutschmannii*.

HERBERTIA 62 • 2008

4. VERACRUZ

A nice temperate climate and lots of forest.



Fig. 21. Possible new species of *Ceratozamia*.



Fig. 22. *Notylia* species – Orchid.



Fig. 23. Skipper butterfly.



Fig. 24. **Any time** is the **right time** for a drink.

5. OAXACA

Oaxaca is a big place with thousands of specialized habitats. There are deserts to cloud forests and everything in between. Over the last thirty years, I have been all over Oaxaca and there still are many places to go and things to see. All of the following (and several more not shown here) are from this last trip only.

A) **Sierra Guiengola** – A limestone mountain with several endemics. *Agave guingola* and *Hechtia* species (Fig. 25). This beautiful *Hechtia* (Fig. 26) almost killed me. I know it looks like you can just reach out and pick them, but it is much farther to walk than it looks and the terrain is very difficult. Here I just ran out of steam and thought I would not be able to walk back to the car.



Fig. 25. *Agave guingola*.



Fig. 26. *Hechtia* species.



Fig. 27. Close up of red *Hechtia* species in Fig. 26.



Fig. 28. Flowering tree in leafless condition.

B) Some areas not too far from the above.



Fig. 29. *Hechtia* species.

Another species of *Hechtia* (Fig. 29, 30) with thick succulent leaves and variously colored scales. All forms of this species are BEAUTIFUL. The extremely beautiful *Agave* species (Fig. 31) is (so far as known) only found in this one canyon. The plant is completely inaccessible. I did find one that fell down but it was too far gone to survive.

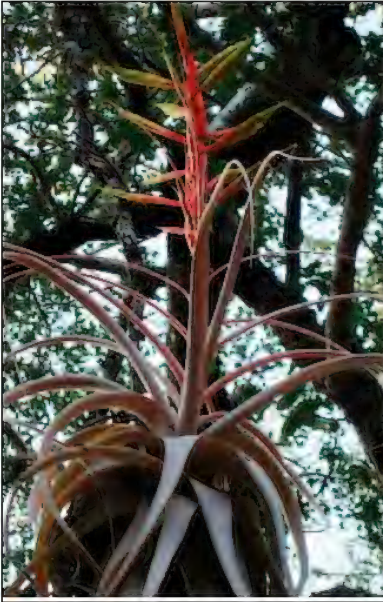
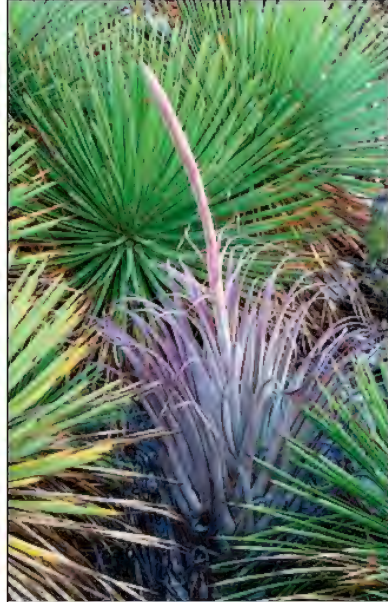
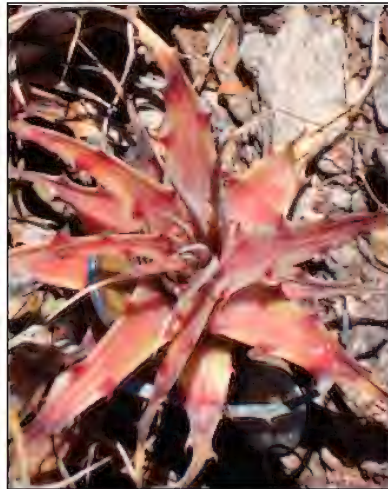


Fig. 30. Close up of silver *Hechtia* species in Fig. 29



Fig. 31. Green *Agave* species.

C) Tehuacan and surrounding areas.

Fig. 32. *Tillandsia tomasellii*.Fig. 33. *Tillandsia roseoscapa* and *Agave stricta*.Fig. 34. Striped *Hechtia* species.Fig. 35. Dwarf *Hechtia* species with coin.

TWO MORE BEAUTIFUL HECHTIA SPECIES (Fig. 34, 35). The one on the right is a dwarf (Fig. 35). Notice the coin which is about in inch wide.

HERBERTIA 62 • 2008

D) El Bocaron



Fig. 36. El Bocaron.

WINTER 2008 EXPEDITION TO SOUTHERN MEXICO



Fig. 37. *Pinguicula* species.



Fig. 38. *Tillandsia* species.

We found *Tillandsia tonalaensis* here as well as a few other species. At the bottom of the canyon it is very moist but the walls are dry. The *Tillandsia* on the right looks like something that should grow in Peru (Fig. 38).

E) San Mateo

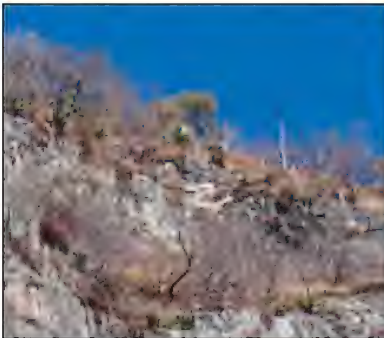


Fig. 39. San Mateo cliffs.



Fig. 40. *Tillandsia atrovioleacea*.

These are the daunting cliffs of San Mateo where *Tillandsia atrovioleacea*, *Tillandsia penascoensis* and *Laelia albida* grow (Fig. 39, 40, 41). I asked a local to go up there and get them. He told me that even his goats fall off

HERBERTIA 62 • 2008

there, and I would have to do it myself! Can you see *Tillandsia atrovioacea* and *Laelia albida* at the top of the photo on the right (Fig. 40)? If you look hard, you can see the pink inflorescence of *T. atrovioacea* on the photo on the left too. I did not realize this species became so large and am glad I went to the trouble to collect them.



Fig. 41. *Laelia albida* and the cliff.

WINTER 2008 EXPEDITION TO SOUTHERN MEXICO



Fig. 42. San Mateo mother.



Fig. 43. San Mateo kids.

This woman who could not speak Spanish, does not have things easy (Fig. 42). She is cooking dinner outside and in addition to feeding herself and her husband, she has to feed four children. Two of her children are shown in their one room house (Fig. 43).

F) Yosondua

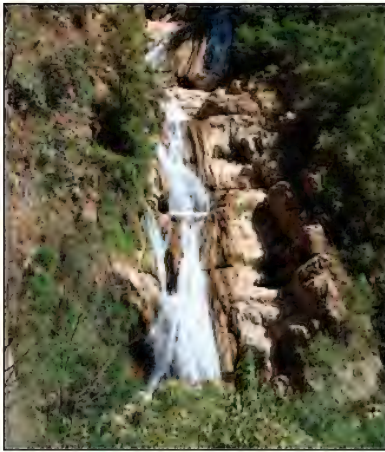


Fig. 44. Cascada Esmeralda.



Fig. 45. Yosondua wasteland.

The beautiful Cascada Esmeralda (Fig. 43) shown next to a nearby area which was once a lush oak forest but was converted to a wasteland by the ancient Mixteca people (Fig. 44). Not all indigenous peoples knew how to take care of their land. We found the beautiful *Tillandsia mixtecorum* here, near the waterfall.

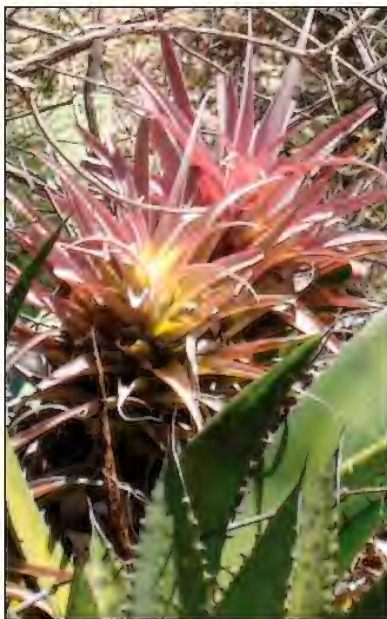


Fig. 46. *Tillandsia rhodocephala*.



Fig. 47. *Tillandsia capitata rubra*.



Fig. 48. *Hechtia nuusaviorum* (red) and an unidentified *Hechtia* (gray).



Fig. 49. Unidentified *Agave* species.

WINTER 2008 EXPEDITION TO SOUTHERN MEXICO



Fig. 50. *Tillandsia fasciculata* with pink leaves.



Fig. 51. *Tillandsia* species.

WINTER 2008 EXPEDITION TO SOUTHERN MEXICO

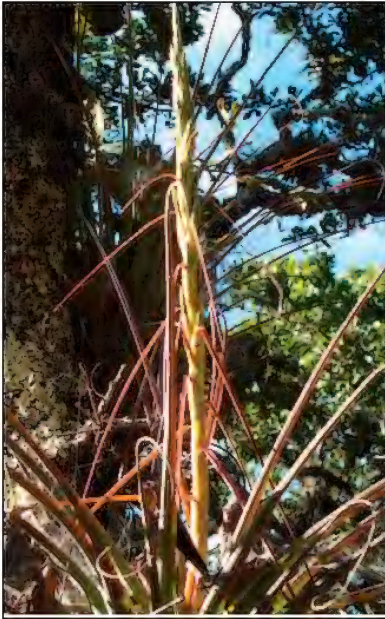


Fig. 52. *Tillandsia* species.



Fig. 53. *Laelia furfuracea*.

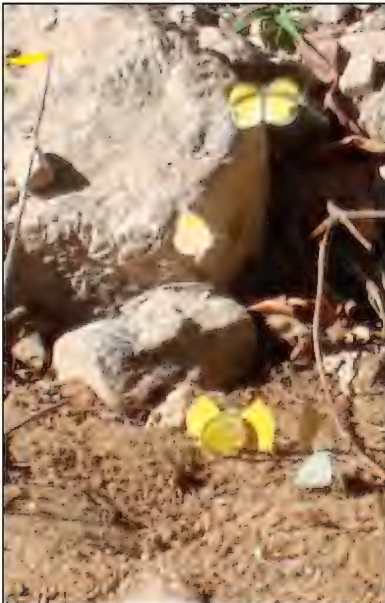


Fig. 54. Butterflies drinking in mud.



Fig. 55. Man in mud after drinking.



Fig. 56. Two Mexican ladies.

On my bed in Mexico, are the two Mexican ladies who slept with me when I was not out looking for plants.

Editors Note: Wrinkle's account can also be viewed at his website www.rarexotics.com

TECOPHILAEA CYANOCROCUS: DEMOLISHING BAD SCIENCE**John M. Watson**

Casilla 161

Los Andes

Chile

E-mail: john.anita.watson@gmail.com

INTRODUCTION

A trio of cardinal points can be established concerning the charismatic and legendary Chilean blue crocus, *Tecophilaea cyanocrocus*, which has been described by a leading authority as “the most beautiful of all the spring flowering bulbs” (Grey, 1938 (Grey, 1938)).

- 1) Its practical history in cultivation up to the present is very good science indeed.;
- 2) The botanical data and records resulting from its original discoveries, together with most subsequent field work might, by and large, be considered indifferent science;. and
- 3) Reports of its supposed massive collection for commerce and total extinction in habitat have proved to be thoroughly bad science, based on misinformation, ignorance, false supposition, second-hand hearsay, repetition of incautious statements, myth and prejudice. Such accounts almost invariably lack any form of investigation or citation.

Tecophilaea cyanocrocus is a frequently publicised species. Presumably most interested parties, whether growers, ecologists or botanists, are aware by now that it has been rediscovered by chance at around 2000 m in its native habitat in the temperate Chilean Andes (Eyzaguirre & de la Huerta, 2002; Rolfe, 2004; Rix, 2007). Wonderful news indeed. (Fig. 1-5)

That news has come to surprise many, but certainly not this writer. My consistently dissenting view arose from the realisation that much potential habitat remains unexplored botanically, and the short flowering season occurs well before any regular upland field trips are underway. My belief that it might not be extinct in the wild has been recorded publicly once before (Watson, 1994), albeit mildly and non-committally by my own standards! However, since the early seventies, when we first visited and came to know Chile, I have often observed that it might be yet more implausible were *Tecophilaea* not still in the wild. Tony Hall: “(Watson) thinks it proba-



Fig. 1. General habitat vista of the population of recently rediscovered wild *Tecophilaea cyanocrocus*.



Fig. 2. Portrait of recently rediscovered *Tecophilaea cyanocrocus* in the wild.

TECOPHILAEA CYANOCROCUS: DEMOLISHING BAD SCIENCE



Fig. 3. A general habitat view of the population of recently rediscovered wild *Tecophilaea cyanocrocus*. (Photograph by M.T. Eyzaguirre.)



Fig. 4. (Right) Recently rediscovered *Tecophilaea cyanocrocus* in the wild. (Photograph by M.T. Eyzaguirre.)



Fig. 5. (Left) Fruit heads of wild *Tecophilaea cyanocrocus* in habitat. (Photograph by M.T. Eyzaguirre.)



Fig. 6. Uncommon *Cyclamen mirabile* in west Turkey. Although not extinct, it has been notoriously over collected for commerce. (Photograph by J.M. Watson.)

ble that wild populations still exist: the Chilean blue crocus once grew on some of the hills around Santiago and nowadays very little botanising occurs at those altitudes in spring.” (Hall, 1995).

“In order to know a species is truly extinct, you have to know it well, including its exact distribution and favoured habitats. You have to look long and hard without result.” (E. O. Wilson, *The Diversity of Life* (1992). Not, it would seem, if you believe irresponsible collectors and their trade backers were to blame for wiping out a once-plentiful plant of extraordinary beauty in the wild, and you feel the world should be told.

True enough, some may be thinking, they did indeed get it wrong for *Tecophilaea*, but so what? Was it such a bad thing using that high-profile example to try to stir the collective horticultural conscience and put the brakes on destructive ‘bulb’ plundering from the wild? My unequivocal answer is, yes. Yes, it was not only bad, but could even prove seriously counter-productive. It was as irresponsible as any other important claim or statement made without careful and proper justification. Sadly, a more than sufficient variety of wild plants which have certainly been removed en masse exists to castigate commercial rapaciousness and selfish, individual greed. The bulk of this depredation is historical, but probably continues. *Cyclamen mirabile* (Fig. 6) (Huxley, 1975), *Sternbergia candida* (Richards, 1993) and

Crocus mathewii (Kerndorff & Pasche, 1996) come to mind as recent well-known and authenticated examples for our proper employment. Mathew & Baytop (1984) have provided precise and staggering export statistics for wild Turkish bulbs. Orchid and Cactaceae specialists could cite equal or worse tales of environmental despoliation by collectors. The point is, such examples must be backed by irrefutable evidence and statistics. *Tecophilaea* never was. Yet it has been high-profiled in the conservation cause. Flagships are key influential elements. Can we expect legislators, charities and other vital funding sources to believe us in the future if they discover how carelessly we cry wolf and accept unfounded data?

FIRST DISCOVERY

At this point it may be worth attempting a little detective work with a view to reconstructing as much history as we can of the discovery of *Tecophilaea*, its status in the wild, its probable trajectory into cultivation, and the likely details of various subsequent fruitless searches. For that we need to consider any known relevant horticultural and botanical activity during those periods. Precise and reliable, information is scarce, but existing clues do form clear patterns and offer good direct and indirect evidence for much that follows. The rediscovery itself is well-documented.

Friedrich (Federico) Leybold (1862) published *Tecophilaea cyanocrocus* as new and collected by himself at Piuquenes in the Cordillera de Santiago (Cowley, 1985). The type was sent to Germany and a photograph of it is filed at SGO, the only herbarium in Chile with any historical reference material. Also in SGO are specimens taken by R.A. Philippi, which he pressed at fruiting time in 1878. The same folder includes drawings and notes by Philippi himself. This material came from the Hacienda Chicureo, just north of Santiago. Eyzaguirre & de la Huerta (op. cit.) indicate that there are further Philippi specimens in Berlin-Dahlem and Paris originating from the Cordillera de Santiago, but without date or other supporting information. Philippi (1865) had included information on *Tecophilaea* earlier in an article about the Chilean flora for a German publication. Collections made by Reed above Santiago for Kew will be discussed shortly in this paper. Whether the same as those above or additional, reliable source locations of corms gathered for the horticultural trade were never identified. It is not clear, therefore, how many sites are involved in total, although there must surely have been at least two, and possibly three, all of them, however, in the cordilleras close to the city of Santiago, and apparently at around

3000 m (Phillips & Rix, 1981). The Cordillera de Santiago, a densely branched network of high peaks, ridges and valleys, is about 100 km long and from 30 to 100 km wide overall. Many ridges top out at around 2000-3000 m. Much terrain at that altitude has never been explored for botany at all, even less of it when *Tecophilaea* is in flower. The Hacienda Chicureo was an extremely extensive mixed agricultural holding, which at the time ran from the lowlands up into the mountains (Eyzaguirre & de la Huerta, op. cit.). Nowadays a luxury housing estate serving nearby Santiago occupies the lower sector. There are mineral mines higher up.

THE ORIGINAL HORTICULTURAL CONNECTION

Two relevant major flurries of historical plant hunting for gardens are known for from the general region where *Tecophilaea* grows (Coats, 1969). The first wave took place during the earlier part of the Nineteenth Century, considerably before 1862 when the Chilean blue crocus was first discovered. It included such collectors as William Lobb, and resulted in the introduction of *Fitzroyia*, certain *Alstroemerias*, *Berberis*, *Escallonias*, and much else (Paxton & Hereman, 1868). Little further happened until the first decades of the Twentieth Century, when the second period was initiated by the visit to Chile and Argentina of H.J. Elwes. By then *Tecophilaea* must have been well established in cultivation. No private or commercial collecting in Chile is recorded historically for the time the species was actually gathered and exported. Horticultural names principally associated with it are Max Leichtlin and Edward von Regel (Muñoz, 1973). Neither ever visited South America. They appear to have been little if anything more than low-level specialist importers, distributors and publicists.

On the other hand, botanical exploration of the Andes around Santiago in the 1860s and 70s stood must be considered as its historical plateau (Marticorena, 1995). Given an initial impetus by John Gillies, who worked out of Mendoza in Argentina during the 1820s (Dawe, 1988), the main Chilean thrust developed and matured subsequently through the physical and intellectual force of the region's two greatest botanical explorers, first Claude (Claudio) Gay, followed by Rudolph Amandus (Rodulfo Amando) Philippi. This intense fieldwork lasted up until the final decade of the Nineteenth Century, supplemented by active collaborators and colleagues, including Leybold. Thereafter, botanical mountain exploration near Santiago subsided dramatically into the Twentieth Century, at times fading completely, and has only begun to pick up again since the 1970s.

Mention should be made here of Edwyn Reed, an English naturalist resident in Chile from 1869 to his death in 1909 (Schell). For the first four years he lived in Santiago, working at the Museo Nacional de Historia Natural, Santiago (Schell, op. cit.), where he became a friend and colleague of R.A. Philippi. Although primarily a biologist, Reed assembled a limited but valuable selection of botanical specimens. These included *T. cyanocrocus*, which makes him the only historical personage other than Philippi and Leybold known to be associated directly with the species *in situ*. Reed's voucher material of *Tecophilaea* was brought back to Kew (Cowley, op. cit.), but is apparently not currently to be found in the herbarium cabinets there (Ehr. Bayer, pers. comm.). He also returned to England with corms, which were unsuccessfully attempted in the Gardens and soon died out. We can be quite sure however that Reed only provided these few sample living plants for Kew and no more (J. Cowley, pers. comm.).

WERE THERE REALLY ANY VILLIANS?

Whether or not Dutch bulb firms were among the early recipients, theirs are certainly the commercial names most associated with *Tecophilaea* since the early days (Hoog, 1961). As the Twentieth Century progressed, so too British amateur horticulture began to dominate successful *Tecophilaea* culture and create demand. These two linked developments engendered a vague but strong sense that 'wicked' Dutch and British growers between them shared the main responsibility for the proclaimed destruction of *T. cyanocrocus* in the wild. This is not only unsupported by evidence, but is unfair and unjust. Other than Reed, the original protagonists in both hemispheres were all German subjects, namely Leybold, Philippi, Leichtlin and Regel, to whom we might add Georg Reuthe (1889) as a minor participant. Reuthe had yet to emigrate to England and found the family plant nursery that would later come to employ me for a year between 1958 and 1959!

Leybold was still publishing in German in European periodicals up to 1873, Philippi as late as 1896 (Marticorena, 1992). Without doubt, these permanent Chilean residents maintained professional and cultural contacts with their land of birth. It is reasonable to speculate that both were staggered by the loveliness of the blue crocus and shared their experiences. It also seems highly improbable Philippi discovered fruiting material by chance. Besides, with flowers unseen, how could he possibly have assumed it to be *T. cyanocrocus*? So did he discover it earlier? Or was it found and described to him by one of his non-botanical collaborators? Or could Leybold somehow have been involved?

Of all the Chilean flowers they knew, this must have been the outstanding, irresistible possibility for garden introduction. Did one or both of them contact Leichtlin and send material, maybe ripened corms taken by Philippi along with the fruiting specimens? Perhaps also seed? We do know of one importation of 2000 corms apparently received by Leichtlin himself in 1869 and passed on to select commercial firms (Leichtlin, 1889). All were the former var. *leichtlinii*. Two thousand may appear a lot to our modern conservation-tuned sensibilities, and to Eyzaguirre & de la Huerta (op. cit.) it clearly does; they qualify it as “una gran cantidad”. However, 2000 units from the wild scarcely registers alongside effective commercial harvests past or present. These are recorded as tens of thousands to millions of ‘bulbs’, or tens to thousands of kilograms, if you prefer weight (Mathew & Baytop, op. cit.)!

I am not suggesting for an instant, and most decidedly do not believe, that Philippi and Leybold went mad and stripped the environment. Quite the opposite. Philippi’s utter reverence for and devotion to nature is legendary in Chile. Surely these two responsible botanists who so adored the Chilean flora would have wanted to share this new glory with Europe, but maintain the operation under their own careful control? Perhaps they even anticipated our modern conservation philosophy: if a desirable plant is readily and cheaply available to gardeners, the pressure to collect is largely removed.

WAS THE BLUE CROCUS EVER ABUNDANT?

In common with numbers of *Crocus* species proper and certain other geophytes, *Tecophilea* evidently tends to form locally confined but extremely abundant colonies. Based on their own spot statistics, a running estimate of the tight-set population found by Eyzaguirre and de la Huerta (op. cit.), which they delimited at 50 x 20 m, would be in the region of 400,000 to 500,000 corms. A published comment to the effect that the Chilean ‘crocus’ stained the landscape blue (Regel, 1889) led later authorities to suppose it a formerly widespread species subsequently decimated by massive, chronic collecting (Muñoz, op. cit.). The relevant correspondence which must have passed between Chile and Germany no longer exists. My best guess sees Regel’s sweeping description as probably derived from a reassurance received by Leichtlin that 2000 corms would scarcely dent its wild community, even before population figures were restored naturally from random wild seed. By all accounts Max Leichtlin seems to have had integrity and was undoubtedly respected, as he still is.

Fig. 7. *Barneoudia chilensis* in the Santiago Andes. As *T. cyanocrocus*, its flowering is precocious and ephemeral, but although less showy it was discovered earlier and is readily encountered due to being widespread. (Photograph by P. Riedemann.)



Other contingent questions arise that seem glaringly obvious. If so spectacular a flower as *T. cyanocrocus* did indeed formerly (i.e. before 1862) stain significant tracts of the Santiago cordilleras blue, as noted in the previous paragraph, why was it not discovered in the previous decades by the several indefatigable and eagle-eyed explorers then active? Why does it not feature more numerous in voucher collections? We have a useful analogy in *Barneoudia chilensis* of the Ranunculaceae (Fig. 7), a kind of pale, southern winter aconite equivalent, which flowers at the same time in the same habitats, as well as appearing and dying back rapidly. Although far less showy, it is truly common in the Santiago region, and was discovered by Gay and published later by him (1845). More to the point perhaps, why has no botanist ever asked these questions before? Could it be that the emotional concept of so exquisite a work of nature ruined by cynical greed has blinded rational scientific thought? I believe so. I will return to the issue of rarely seen, eye-catching plants in populated regions.

FALSE TRAILS

Concern to protect this precious, rare discovery from unprincipled collectors may have verged on paranoia. Vague or downright absurd geographical misinformation given for sites of collection can surely be taken as a smoke-screen, although field notes of the era do frequently leave much to be desired. We need not assume either that Leichtlin, as sole agent, was acting venally to maximise his personal economic profit. Clearly not, since he shared generously from the outset. To be known as the introducer of a fine plant is reward enough of itself for many of us. A misleading, commonly seen location – between Santiago and Valparaiso – seems to have come about later. The wildly fake placement on the Juan Fernández Archipelago (Robinson Crusoe Islands) way out in the Pacific, as cited by Regel (op. cit.), has been generally accepted as nothing less than a deliberate ploy to kill off the scent for commercial opposition. True or not, the thought of packs of frustrated piratical plant grubbers shipwrecked on Defoe's island for decades on end and tucked (almost) out of harm's way is wickedly delicious! Discordant views exist about a pair of German nurserymen, Haage and Schmidt. Some cite them as unscrupulous rivals and the main reason for the Juan Fernández bluff (e.g. RBG Kew, CPDU, 2006). Others assess them as trusted colleagues of Leichtlin in the 'official' introduction process (e.g. Stapf, 1923., J. Cowley, op. cit.). Yet again we find a lack of unambiguous information, but the fact that they were the first to catalogue *T. cyanocrocus* (J. Cowley, pers. comm.) strongly supports their official participation.

GRAND LARCENY, THE ACCUSATION

So is there support for this consensus of massive collecting for commerce over a prolonged period? No substantial evidence exists. But might it even have taken place? If we continue to insist seriously on major cynical exploitation for gain, certain consequential questions must be addressed:

- What if an anonymous European entrepreneur somehow evaded general attention?
- What income would have justified the journey, time and expense involved, as well as setting up and funding a local means of digging and exporting over future years?

- What quantity of corms might have provided it, even at a high initial return per unit? Would there have been a market for, say, half a million corms, each one at an astronomical price? Surely access to wild *Tecophilaea* must also have entailed the active co-operation of Leybold, Philippi, or both. Can we imagine them conniving in such rapacious plunder without demur or recorded outrage? And why did these hypothetical Europeans not send back examples of the many other attractive geophytes in central Chile?
- What about native Chilean collectors? We must then presume either that Leichtlin somehow contracted them directly, without Philippi and Leybold knowing, or else the latter were even more active in the purported ecological crime.
- A voyaging non-botanical intermediary, either European or South American, could certainly have transported the corms back in person. This alternative again cannot avoid involving the two German-born botanists.
- So if one or both of them were indeed so callously indifferent, why not simply arrange collection and shipment of corms directly themselves?

That review probably covers every likely circumstance by which *T. cyanocrocus* might have been collected in Chile for export to European horticulture. It must also be taken for granted that whoever was involved must either have been able to identify *Tecophilaea* or have known someone who could. Quite clearly, no hypothesis involving massive, chronic and irresponsible extraction ought to make sense to us.

We should now turn our attention to examining known circumstances in Europe at the time with a view to assessing whether or not they might support supposed mass trading in wild-collected blue crocus corms. If we still allow that such an operation might have taken place on such a grand scale over time late on in Nineteenth Century horticulture, is it really likely to have left no clear recorded trace? Think of the advertising needed to dispose of that quantity of a dazzling novelty! Were cultivators of the time so unskilled that such vast amounts of so prized a beauty failed in cultivation, or was interest in lovely rarities so low that it scarcely left a mark in the written records?

Ultimately then, we are left with one hypothetical realistic negative scenario. A very few extremely localised but profuse populations close to Santiago, probably no more than two, form the basis of this reconstruction.

It is then necessary to accept that these were dug regularly over a number of seasons in such quantity that they were reduced sufficiently in number to be incapable of replenishment, even by seed, and so eventually went extinct. The cynically deliberate involvement or connivance of one or all of Philippi, Leybold and Reed is an unavoidable consequence of accepting this version. There is absolutely nothing in what we know of these three responsible scientists to support such an accusation. Quite the reverse. We were also informed some time ago on good authority at Kew that introduction from the wild was modest and possibly even one-off (M. Sinnott, pers. comm.).

If the very few, very limited original historical populations of *T. cyanocrocus* near and above Santiago are indeed no longer extant, we should be looking for logical and supportable alternative explanations such as habitat destruction or overgrazing, including trampling of sensitive foliage by cattle or horses.

PETTY THEFT, THE REALITY

The failure of the first Kew introduction seems rather surprising in view of its latter-day buoyant success in the hands of Tony Hall and staff there. Otherwise strong support for the 'introduction from small beginnings' version is supplied by continual references, both historical and current, to the relative ease of raising from seed (e.g. Hoog, op. cit.; Mathew, 1993). This applies to both amateur and commercial spheres, and would have obviated, or at the very least significantly reduced, the demand for heavy, successive wild corm extraction. When happy the species also reproduces vegetatively with vigour. I can personally recall a time around the middle of the last century when Irish bulb nurseryman Ralph Cusack was noted for regular inclusion of *Tecophilaea* in his charismatic list. Indisputably, his stock was raised and not taken from the wild.

THE HUNT FOR THE MISSING TRUE BLUE

It should be recognised that in a limited but important sense *T. cyanocrocus* is indeed, if not extinct, then certainly undiscovered in the wild. For no locality is presently known for the famous and best-known type cultivar, the all-blue form (Fig. 8). Again, my instinct tells me it is probably still 'out there' somewhere. This also leads to further perhaps unanswerable questions about the origins of the two major colour forms in cultivation. It seems highly probable they resulted from separate importation and different wild colonies. Otherwise there must have been variability during propaga-

Fig. 8. *Tecophilaea cyanocrocus*. An example of the typical form. (Photograph by R. Rolfe.)



tion from seed. However, there is an unsubstantiated report of various colour forms growing together in the wild (Cowley, op. cit. & pers. comm.) At all events, it seems reasonable to suppose that the predominant gentian-blue form was the principle and original introduction. Forma *violacea* (a now superseded rank) evidently did result directly in cultivation, so a third postulated shipment is not required to account for it.

Extinction in the wild as the fate of the blue crocus appears to have occurred for the first time as a sincere conclusion around the middle of the Twentieth Century, in Chile at least (Eyzaguirre & de la Huerta, op. cit.). Knowledge of any such searches as led to this belief and of any subsequent fieldwork suffers from lack of written reports. I suspect too that those searches themselves suffered from lack of adequate primary information as to where *Tecophilaea* was originally discovered. That no planned, extensive, concentrated search of likely habitats between 2000-3000 m has ever taken place in the Santiago cordilleras during October seems quite beyond doubt.

Only one modern Chilean explorer in the central cordilleras, a fine amateur botanist called named Carlos Jiles, has a substantial field curriculum in the tradition of Gay and Philippi (A. R. Flores, pers. comm.).

However, Jiles worked exclusively in Coquimbo Province, considerably further north than the known and supposed distributions of the blue crocus.

No more than two deliberate, interested searchers are known to us by name; Carlos Muñoz, Director of the Botany Section of the Santiago Natural History Museum up to the 1970s, and his amateur horticultural contemporary, the late Dr. Roman Wygnanki, a dentist by profession, who corresponded with British gardeners. Precise details of their field work are unknown. We gleaned from our conversations with them that they only covered the ground where they believed *Tecophilaea* had originally been found. Without doubt Wygnanki is the “correspondent in Chile” who sent information about its accepted extinction to the notable English gardener, E.B. Anderson (1973). Anderson not only published this reported event, but sent Wygnanki *Tecophilaea* as corms, which we were shown flowering in his Santiago garden in 1971, and which appeared as a colour photograph in the book by Muñoz (op. cit.). Coals to Newcastle!

REDISCOVERY

Understandably, Eyzaguirre and de la Huerta decline to reveal the precise location of their chance rediscovery. Responsibility for a rarity rests primarily on whoever finds it, and also after that on any who are subsequently privileged to share the event. We applaud their concern. Despite our own conviction that the blue crocus is so well established in cultivation that it simply would not repay uprooting commercially, it is impossible to be too cautious. Besides, the temptation to harvest seed in quantity might be considerably less resistible. To their credit they have revealed as much as they feel free to offer of other useful details about habitat, elevation, climate, soil and floral community, all of which may be found in their paper (op. cit.). Among the most interesting and valuable data is the actual broad geographical location, ca 40 km south of Santiago, which is well distanced from the presumed locality of the historic collections. The population was almost 100% homogeneous in flower colour, resembling the former variety *leichtlinii*, but also including three albinos.

THE THREE CULTIVARS AND THEIR OFFSPRING

A short explanation of the current and historic taxonomic status of the differently coloured variants adds to the picture.

Leybold's type specimen is universally accepted as having strong gentian-blue flowers with a few thin white lines radiating at the centre. It has

always been known simply as *T. cyanocrocus*.

A variant evidently also derived straight from the wild, which arrived in cultivation a few years later, was recognised and first published as var. *leichtlinii* by Regel (op. cit.), but not validly. It was adopted as a horticultural nomen nudum up until 1994, and was recently also referred to in botanical literature (Eyzaguirre & de la Huerta, op. cit.). Since 1994 it has been converted to a valid cultivar, *Tecophilaea cyanocrocus* 'Leichtlinii' (Fig. 9), which is how it now stands. The purest form of this has larger flowers than Leybold's original, with the basal two thirds white and the remaining distal third of the tepals a much softer sky-blue. Cultivar names coined as Latin epithets before 1959 may be retained, as here. After that year new names must be in a modern language to conform with the rules of horticultural nomenclature (Philip & Lord, 2003). As noted, the only currently known wild colony of *Tecophilaea* corresponds closely to this cultivar, is quite uniform, and also produces rare white forms.

The remaining variant arose exclusively in cultivation. There are no records of its existence in the wild. It again appeared fairly early in the history of the species and was given the invalidly published Latin epithet, forma *violacea*. This too continued up to 1994, after which it was also correctly presented in cultivar form as *T. cyanocrocus* 'Violacea' (Fig. 10). As the name suggests, this form has flowers of an indigo-violet tone, but otherwise corresponds with Leybold's original.

All three above have received an impressive array of British cultural awards between them – First Class Certificates, Awards of Merit, Preliminary Commendations and Awards of Garden Merit – as well as having gained many prizes for their exhibitors.

If different cultivars are grown together, intermediates, or even intermediate swarms can appear from resulting seed. Since 1995, slightly variable plants of the parentage 'Leichtlinii' x 'Violacea' have been distributed under the grex name 'Storm Cloud'. They combine the predominant white centre of the former with the deep coloration of the latter (Rolfe, 2000). Tony Hall (op. cit.) discusses differences which can occur in seed-raised 'Leichtlinii', when a number of variable individuals may more or less approach the type in intensity of blue, with notable reduction of the white base. He questions whether critical rather than 'aesthetic' separation could be justified. A photograph of just such a mixture accompanied his text.

In truth, as noted in another context by Brian Mathew (op. cit.), we simply do not at present know enough about variation within and between



Fig. 9. Variable seedlings raised from *Tecophilaea cyanocrocus* 'Leichtlinii'. (Photograph by R. Rolfe.)



Fig. 10. *Tecophilaea cyanocrocus* 'Violacea'. (Photograph by R. Rolfe.)

wild populations at large of *Tecophilaea cyanocrocus*, and may never know. In view of this lack of knowledge, and so long as it persists, formal infraspecific ranks have no place in its botanical taxonomy.

NOW YOU SEE IT, NOW YOU DON'T

Brian Mathew (op. cit.) also mused how such a brilliantly striking species might elude attention for long so close to Chile's capital. This seeming paradox may be readily explained in terms of a few particular interacting circumstances. *Rarity*, whether *innate* or resulting, is fundamental, of course. Further contributing factors might include: *specialised and localised habitat*; *growth outside the main season*; *an ephemeral tendency*, *above all in flower*; *relatively small-sized life-form*; *occurrence in unexplored or seldom visited likely habitat*; *vastness of potential terrain*; *distance from regular 'beaten tracks'*; irregular flowering from season to season; and faulty or *imprecise records*. Factors in italics all apply to *T. cyanocrocus*.

The contrast with common but less showy *Barneoudia chilensis* has been made above.

Pink, checkered *Fritillaria alburyana* (Fig. 12) is quite unlike any other of its genus. As obviously attractive as *Tecophilaea*, if more quietly so, it shares many of the latter's ecological and life-cycle traits. It grows on one of Turkey's major eastern passes, but was not recognised and named until 1971. A mere thirteen years later it was recorded from no fewer than seven stations (Rix, 1984).

An equivalent Chilean show stopper is *Tropaeolum hookerianum* ssp. *austrorubrum* (Fig. 13), an easily seen climber beside a 30 km stretch of the principal PanAmerican highway in populated Coquimbo Province (Watson & Flores, 2000). Although not uncommon locally, it had to await scientific recognition until just before the millenium. Erratic flowering every several years, and being an element of a floral guild (an exact colour match with common taxa in its habitat), preserved it from earlier botanical discovery.

Perhaps the most striking example on offer from the same regions is our own recent discovery of an alstroemeria, tentatively identified as *Alstroemeria* aff. *crispata* (Fig. 14), and perhaps conspecific. It grows quite plentifully right alongside a long-established major road pass. Although small, the pink umbellate inflorescence is by no means inconspicuous. The pass area is considered to be thoroughly combed botanically. Our plant, however, flowers somewhat later than other alstroemerias in the zone and has consequently eluded all formal botanical investigation until now.



Fig. 11. Seedlings raised from a dark form of *Tecophilaea cyanocrocus*. (Photograph by R. Rolfe.)



Fig. 12. *Fritillaria alburyana* on Çakmak Dag, east Turkey. Its ephemeral flowering habit as compact, discrete populations corresponds closely to *T. cyanocrocus*. (Photograph by J.M. Watson.)

Fig. 13. *Tropaeolum hookerianum* subsp. *auropurpureum*, a showy taxon from the coast of Chile's Coquimbo Province, where it grows alongside the main arterial road. However, it was not found until the late 1990s. (Photograph by J.M. Watson.)



Fig. 14. Showy little *Alstroemeria crispata*, very recently noticed for the first time right beside a long-established major road pass. (Photograph by J.M. Watson.)

RETURNING THE NATIVE

The feasibility of re-introducing *T. cyanocrocus* to the wild from cultivated stock was aired publicly by Mathew (op. cit.). The idea had also independently occurred to ourselves slightly earlier as an exciting proposition, provided it had a sound practical basis. We were aware from details in Eyzaguirre & de la Huerta (op. cit.) and discussions at Kew (M. Sinnott, pers. comm.) that this concept was being developed later as a project by a bi-national Kew-led conservation consortium. Outline details of the existing historical knowledge that informed it originally, the way *ex situ* genetic variation (cultivars, etc.) was to be approached, and future intended steps may be found at their website (RBG Kew, CPDU). It is not known if the recent re-discovery has affected those plans. Our own current view is that there may be insufficient critical information at various levels to raise hope for the success of any such intervention, although recent knowledge of the species in the wild is undoubtedly of great benefit.

THE BABY TECOPHILAEA

The second and only other species in the endemic Chilean genus *Tecophilaea*, *T. violiflora* Bert. ex Colla, is sporadic but widespread along most of the Pacific northern mediterranean- coastal sector of Coquimbo Region. To the south of its range it extends somewhat inland, including through Aconcagua Province, and just reaches as far as the Santiago area (M. Muñoz, 1985, Marticorena et al., 2001). (Fig. 15-19).

Occasional puzzling assertions of its existence in Peru and S. Brazil (Synge, 1961; Ferguson, 1967) are wholly inaccurate. It was published in 1836 (Colla) simultaneously with the launch of its family, Tecophilaeaceae, eccentrically and variously spelt at times by authorities (e.g. Miers, 1863; Leybold, 1863). The family was subsequently rejected for a long period before its modern universal re-adoption (Marticorena & Quezada, 1985). Alternative families have been Cynastraceae (Chant, 1978) and, most commonly, Haemodoraceae (Brummitt, 1992).

Tecophilaea violiflora, very early flowering and rather ephemeral, is a pretty enough little thing, and it truly is little, usually also of a startling bright blue like big sister, but turquoise by comparison, not gentian. On account of that 'semi-precious' colour alone, its best forms would be worth growing in any specialised 'bulb' collection with minimal frost protection. Its specific name has generated a minor controversy, having confused garden writers in particular into assuming its colour as usually or always violet

TECOPHILAEA CYANOCROCUS: DEMOLISHING BAD SCIENCE



Fig. 15. *Tecophilaea violiflora*, the northern white form. (Photograph by J.M. Watson.)



Fig. 17. *Tecophilaea violiflora*. A less turquoise blue form from the El Melon pass, Aconcagua Province. (Photograph by A.R. Flores.)



Fig. 16. *Tecophilaea violiflora*. A flower of the northern white form showing the somewhat irregular shape and its equivalence to the typical corolla of *Viola* species. (Photograph by A.R. Flores.)



Fig. 18. *Tecophilaea violiflora* in habitat. A darker blue southern form from the El Melon pass, Aconcagua Province. (Photograph by J.M. Watson.)

TECOPHILAEA CYANOCROCUS: DEMOLISHING BAD SCIENCE



Fig. 19. *Tecophilaea violiflora*. Coquimbo Province. (Photograph by J.M.Watson.)

or mauve (e.g. Synge, op. cit.; Ferguson, op. cit.; Phillips & Rix, op. cit.). In fact the name almost undoubtedly refers to the tepals being held in a slightly asymmetrical pose so as to fancifully resemble the shape of certain violets (*Viola* spp.). Had colour been intended, why not *violicolor* or *violacea*? In fact the far northern populations are invariably all-white, and we have certainly never seen a violet-coloured specimen ourselves, or an illustration, although they have apparently been reported rarely.

THE CONTENTED CAPTIVE

"No, no ... this glorious Gentian-blue Crocus from Chile is quite impossible of general cultivation in England". Thus wrote the incomparable Reginald Farrer (1919). Well, that was then and this is now. So an authoritative contemporary alternative view is provided in Beckett (1994): "Despite conflicting comments, not difficult to grow in sheltered sunny nooks outside providing the soil is fertile and well-drained, and screened from too much summer wet when dormant. Fairly easy in pots in the alpine house."

Here is not the place to detail techniques of growing the blue crocus. However, recalling massed ranks of flowering plants which do not submit humbly to cultivation tells its own tale. The formal, oblong stretch of intense shimmering colour produced in Kew's frames by Tony Hall and his team was unforgettable. It could have been some miniature celestial swimming pool. Not every would-be grower shares Tony's genius to put the formidable Farrer so firmly in his place *post mortem*. Even the original late Nineteenth Century efforts by Kew itself met with failure (J. Cowley, pers. comm.). By contrast, R. Bevan (A.G.S., 1961), reported *Tecophilaea* as perfectly hardy outdoors in parts of Britain, citing a twenty yard strip in Sussex. Three further decades on though, an unattributed account (Anon., 1990) noted that it no longer grew so prolifically out-of-doors as before, a situation possibly related to climate change. Following on, several later reports mention the vulnerability of its precocious shoots to late frosts and recommend protection at that stage unless growing conditions are reliably mild (e.g. Rolfe, 2002).

Clearly there appears to be something of a see-saw effect in its response to cultivation over time, but, fortunately though, nothing to critically threaten its firm and wide foothold in our midst. Its history with us is well summed up by: "numerous records of spectacular successes to offset the litany of failures" (Rolfe, 2002). Until the end of the first half of the Twentieth Century it scarcely figured outside highly specialised literature.

Since then it will be found in virtually every general gardening encyclopedia (e.g. Hay & Beckett, 1971; Hellyer, 1993; Brickell, 1996). An increasing frequency of mentions in the periodical literature of horticulture suggests it is becoming ever more securely established. Apart from in Europe, the blue crocus is also now well established in such widely separated nations as the United States, Japan and New Zealand.

POACHERS OR GAMEKEEPERS

Despite fluctuation of its fortunes in individual hands, a constant and steady output of *T. cyanocrocus* in quantity has always been provided by the horticultural bulb and nursery trades. At one time suppliers were extremely limited in number. Immediate post-war British gardeners regarded the legendary Ralph Cusack of Ireland, with reverence and awe. By contrast 13 traders were very recently listed for the British Isles alone, with all four cultivars on offer (Philip & Lord, op. cit.).

The spread, stability and high level of expertise provided by commerce and amateur plantsmen in 'symbiosis' has triumphed in this particular case. A good distribution on the ground for demanding plants is particularly valuable, if not vital, and is something botanic gardens on their own cannot readily supply, if at all at times. "The Kew collections of *T. cyanocrocus*, originally obtained from a commercial nursery, Van Tubergen, are genetically highly uniform" (Maunder et al. 2001). It not only hedges healthily against risks and disadvantages, but also tends to maximise genetic diversity and select or 'seek out' optimum circumstances, as well as providing potential for far greater stock increase. This situation proved to be pivotal for the secure tenancy of *T. cyanocrocus* in captivity, even allowing it to ride out the considerable horticultural traumas in Europe of two world wars. Given that the original importations were indeed responsibly modest, this outcome could hardly be surpassed as *ex situ* conservation.

It has become fashionable for certain powerful elements of the scientific community to criticise and downplay commercial and amateur horticulture, as well as the usually responsible freelance small collectors who nurture them. As a 'politically correct' dogma this does no overall service to the wellbeing of our world flora.

"Good science may flourish in a back yard."

APPENDIX: SOME RELEVANT QUOTES

No matter by whom, concern for rare plants or any already extinct in the wild is unquestionably admirable. That includes actions to save or better their situation. However, as the *Tecophilaea* story reveals, it should be unprejudiced and inclusive. The only consideration should be the most effective course for plants themselves. The series of errors which have attached to *T. cyanocrocus* need to be teased out carefully from these good intentions (e.g. Fay, 1998; Maunder et al., 2001).

Concern for truth must also be paramount. Recklessly careless conclusions about conservation status are worrying, in particular those published by the academic scientific community, which should live by the high standards it sets itself. These conclusions have nurtured and been nurtured by grossly unfounded and unjust accusations against the horticultural world. Deplorably, the authorities of that world have often been all too willing to declare it guilty without trial rather than consider their overriding responsibility to defend its good name, its positive actions, and the interests of those who depend on it. The present writer shares that guilt to a small degree.

FACT AND FICTION

The following selection from serious publications illustrates these points. This author accepts full responsibility for removal from context and for any translations:

“EXTINCT IN THE WILD” (EW)

“A taxon is Extinct in the Wild when only known to survive in cultivation, in captivity, or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon’s life cycle and life form.” IUCN (2006).

[*Four specific IUCN factors are of special relevance for Tecophilaea cyanocrocus. Firstly, in their category Extinct (EX), the additional criterion “of no reasonable doubt” is stated, which certainly must also apply to EW. Secondly and thirdly, the criteria “exhaustive” and “expected habitats” are fundamental here. Finally, concerning the requirement “historic range”, our critical lack of precise, working knowledge of this for Tecophilaea cyanocrocus must be taken into account.*]

CAUTIOUS AND REASONABLE

Tecophilaea cyanocrocus is a very rare ... plant ... found locally ... in the Chilean Andes. ... In its native home *Tecophilaea* has only a short growing season, during September and October (the spring months of the Southern Hemisphere), after which the pastures it inhabits become entirely parched. In the winter the plant is covered by snow (AGS Preliminary Commendation note on the cultivar 'Leichtlinii'. Anon., 1957b).

- thought to be extinct in the wild now, but its future is assured, for its beauty will save it in cultivation (Mathew, 1974).
- I know of very few examples where 'bulbs' (in the widest sense of the word) have been over-collected to the extent that there is a danger of the species as a whole disappearing. ... *Tecophilaea cyanocrocus* ... is generally acknowledged to be extinct in the wild, although absence is a difficult thing to prove in vast mountain ranges.
- it does seem unlikely that anything as striking as the blue crocus could go un-noticed for long (Mathew, 1993).

[*Apart from one comment (see below) on over collecting, Mathew, a responsible and professional scientific botanist, avoids making unqualified claims for the extinction of the species in all his relevant papers and articles, e.g. 1973, 1997.*]

- There are no recent reports of this species in its Chilean homelands: luckily it has taken well to life in exile (Hunt, 1996).
- Quite a number of species are now thought to be extinct in the wild, but persist in cultivation, including *Tecophilaea cyanocrocus* (Richards, 1993).
- not seen for many years and presumed extinct (Beckett, 1994).
- probably now extinct in the wild (Brickell, 1996).

CONTAINING PARTIALLY OR TOTALLY UNSUBSTANTIATED INFORMATION

- In fact a classical site when re-visited was found to be trampled out of existence by cattle. (Anon., 1957a).
- (It) was found in the Chilean Andes between Santiago and Valparaiso at about 10,000 ft., where it is now believed to be extinct as a result of grazing cattle and irresponsible collecting (Ferguson, 1967).
- Partly from over-collecting and possibly also from over-grazing by cattle this lovely bulb had, according to my correspondent in Chile, become extinct in the wild (Anderson, 1973).

- It is now possibly extinct in the wild through over collecting (Phillips & Rix, 1981).
- Collecting and cattle ranching have in all probability completely destroyed the beautiful blue *Tecophilaea cyanocrocus* (Richards, 1993).
- As far as I can ascertain, it was last seen in the 1930s and although it was undoubtedly collected on a considerable scale its eradication was apparently also due to in part to overgrazing by cattle (Mathew, 1993).
[Although cattle destruction is a very feasible hypothesis, no first-hand reference of direct observation has been found while researching for this account. Neither has data on any sighting during the 1930s.]
- (Other causes) are no less likely final mortal blows than spade-wielders in the pay of villainous Dutchmen, however much contributory damage that may also have done (Watson, 1994).
- Due to the ornamental potential of its blue flowers, its corms were collected in large numbers and exported to Europe. (Eyzaguirre & de la Huerta, 2002).
- It abounded in such quantities as to colour the region blue (Regel, 1889).
[Regel never even visited Chile, yet his is the only information indicating an original wild, widespread abundance of *Tecophilaea* in the Santiago mountains. What was his source, and why were subsequent authorities prepared to accept such an unsubstantiated statement so uncritically?]
- After Regel called attention to its ornamental beauty, it was sought intensively and its bulbs were dug up and sent to European plant traders. So intense was the successful searching that it is no longer possible to find a solitary example (Muñoz, 1973).
- (*Tecophilaea cyanocrocus*) was described in 1862 by Leybold, who emphasized the ornamental qualities of the plant. Hearing about this exotic beauty, horticulturalists got so enthusiastic collecting it, that today, not one single *Tecophilaea* can be found in habitat (Hoffmann, 1989).
- *Tecophilaea cyanocrocus*, which no longer grows in the wild (Grau, 1992).
- The Chilean blue crocus (*Tecophilaea cyanocrocus*) which is extinct in the wild ... (Fay, 1998).
- *Tecophilaea cyanocrocus* ... (is) ... extinct in the wild as a result of overharvesting by commercial collectors. (Maunder et al., 2001).
[A selection of typical, unsupported extinction statements is quoted above. There have been many more, the majority by less qualified writers. Most commentators assume trade collection to have been a (or the) prime cause.]

AND FINALLY... IGNORANCE IS BLISS

At least we know its classical habitat, high foothills with a mediterranean-type climate, and a shortish, dry-grassy, early spring meadow ground flora, often complimented by open acacia savannah. *It is not alpine (Watson, 1994).

[*Even Homer nods!]

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HERBERTIA 62 • 2008

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PRESUMPTIVE NATURAL HYBRIDS BETWEEN *CRINUM UNIFLORUM* AND *CRINUM ANGUSTIFOLIUM* (AMARYLLIDACEAE) IN AUSTRALIA**David J. Lehmiller**18173 Hwy 326 North
Sour Lake, TX 77659 USA
E-mail: drcrinum@aol.com

In late November – early December, 2008, the author, accompanied by Jim Lykos and Nancy Lehmiller, set out upon a field-collecting expedition into Northern Territory, Australia. On the second day of our one week’s “excursion” into rural Australia, we encountered a population of *Crinum uniflorum* F. Muell. (Fig. 1, 2, 3) near the Leaning Lake Lagoon Nature Park, approximately 90 km east of Darwin via the Arnhem Highway. The colony of bulbs was situated within an open to partially wooded locality prone to seasonal inundation during the rainy season. As we began to explore and to photograph the colony, we noted two instances of taller 3-4-flowered scapes (Fig. 4, 5) within the colony. The latter immediately caught our attention because *C. uniflorum* generally holds true to its namesake, as only occasionally does it ever produce a 2-flowered scape (perhaps 1 in a 100 scapes will have 2 flowers). The *C. uniflorum* bulbs were very small bulbs with slender linear leaves <3 mm wide, whereas the bulbs bearing scapes with 3-4 flowers had wider, sturdier, channeled leaves measuring 7 mm wide; several other non flowering bulbs were also noted to have similar, wider channeled leaves. (No determinations could be made regarding seed fertility of these larger bulbs since it was early in the flowering season.) The thought that these were “hybrids” entered our minds. But from where had the exogenous pollen originated?

The only other *Crinum* species we had observed within the surrounding region was *C. angustifolium* R. Brown, a species commonly found along creek/river banks and flood plains; it was certainly another water loving species, and since it was a much larger species with “similar” flowers and wide channeled leaves (leaves usually circa 3-4 cm in width), it was the likely pollen candidate. We began to search the immediate area, and within minutes, we discovered a cluster of flowering *C. angustifolium* bulbs (Fig. 6) located <100 m from the western edge of the *C. uniflorum* colony. We examined the ground about the *C. angustifolium* bulbs but saw no evidence of intermediate bulbs or obvious hybrids.

Later on during our travels, we recorded two other instances where *C.*



Fig. 1. Habitat of *Crinum uniflorum*, near the Leaning Lake Lagoon Nature Park, Northern Territory, Australia, November 30, 2008. (All photographs by the author.)



Fig. 2. *Crinum uniflorum* in bud. Note the dark slender green leaves which are narrower than the surrounding grasses.

PRESUMPTIVE NATURAL HYBRIDS BETWEEN *CRINUM UNIFLORUM* AND *CRINUM ANGUSTIFOLIUM*



Fig. 3. *Crinum uniflorum* in flower. Note the slender, linear grass-like leaves.



Fig. 4. Presumptive hybrid between *C. uniflorum* and *C. angustifolium*. Note the wider channeled leaves and longer scape.

PRESUMPTIVE NATURAL HYBRIDS BETWEEN *CRINUM UNIFLORUM* AND *CRINUM ANGUSTIFOLIUM*



Fig. 5. Presumptive hybrid between *C. uniflorum* and *C. angustifolium*.



Fig. 6. *Crinum angustifolium* in flower. These bulbs typically have leaves circa 3-4 cm in width.

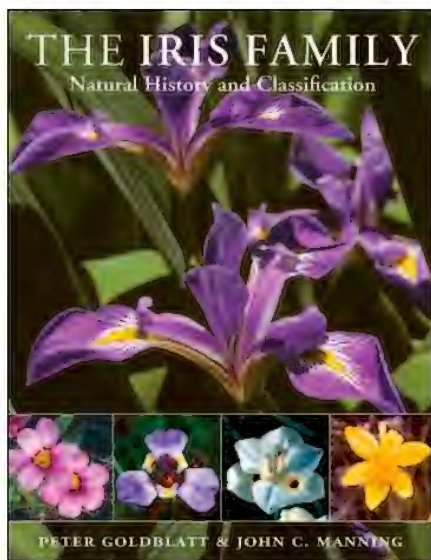
uniflorum and *C. angustifolium* populated the same general-type habitat (seasonal inundated areas), again growing close to each other but not side by side. However, we did not observe any more natural hybrids.

On rare occasions during field expeditions, the author has come across presumptive, natural interspecific hybrids of *Crinum*. This phenomenon is likely more common than appreciated because such occurrences escape detection other than during peak flowering times. The following additional instances and locations have been observed by the author during previous expeditions: 1) Between *C. forbesii* and *C. macowanii* in Transvaal, South Africa; 2) between *C. paludosum* and *C. macowanii* in Namibia; 3) between *C. broussonetii* and *C. humilis* in Cameroun; and 4) between *C. broussonetii* and *C. pauciflorum* in Tchad. Also, Greg Pettit of Natal, South Africa, has shared with the author presumptive natural hybrids between *C. forbesii* and *C. acaule*. None of these presumptive hybrids, including the current example, has been examined by chromosome analysis or DNA content, although several have proved to be seed fertile. Natural hybrids of *Crinum* have never been studied regarding chromosomal makeup; however, in a series of 16 unidentified *Crinum* cultivars (presumably hybrids), Raina (1978) found that polyploidy was present in 4 instances (25%). Hybridization and polyploidy are important mechanisms in sympatric speciation (Raven et al, 2005).

REFERENCES

1. Raina, S.N. 1978. Genetic mechanisms underlying evolution in *Crinum*. *Cytologia* 43:575-580.
2. Raven, P.H., Evert, R.F., and S.E. Eichhorn. 2007. *Biology of plants*. W.H. Freeman and Company, New York.

BOOK REVIEW



The Iris Family. Peter Goldblatt & John Manning. Timber Press, Portland. November, 2008. Hardcover, 290 pp, 65 line drawings, 233 color photos. ISBN-13: 9780881928976.

Gardeners are well aware of Peter Goldblatt's previous books Gladiolus in Southern Africa, The Moraeas of Southern Africa and The Woody Iridaceae. Each is a colorful, classic reference. Since their publication, much has changed in the Iridaceae. I believe the last book to cover the entire family was Clive Innes' The World

of Iridaceae (1985). Peter is one of the leading investigators of this family and has created many of the changes in his extensive publications. There is no one better qualified to write this review of the family. Re-evaluations and changes will occur but Peter has created a baseline reference which will become a landmark in botanical literature. It updates all aspects of research within the Iridaceae.

The book is divided into two parts. The first third of the book covers the anatomy and natural history of the plants. The remainder of the book is the classification section.

In the discussion of morphology, structures like leaves, flowers, etc. are discussed, one at a time, explaining the diversity present. In many cases, Goldblatt proposes the purpose of various adaptations. This speculation may suggest methods of cultivation to gardeners. Although Goldblatt attempts to eliminate needless jargon, the number of anatomical terms may be daunting. Thankfully, he also provides a glossary. His current review of cellular anatomy, phytochemistry, and chromosome numbers is also valuable. Goldblatt summarizes the natural history with an emphasis on pollination biology.

The classification section of the book discusses the evolution of the fam-

ily and offers a page of maps showing the configuration of the continents at various geologic times. There are dichotomous keys that direct us to the correct subfamily and then to the proper genus. Each genus is provided with one or more line drawings by John Manning. Although excellent, the incredible diversity of species within some genera cannot be adequately conveyed by only sixty-five drawings, but more would be beyond the scope of this book. Nonetheless, 66 genera are described and illustrated.

Some years ago, I chaired an international symposium on *Iris* at which George Rodionenko, Brian Mathew and Peter Goldblatt spoke. I mentioned to Peter that Brian included many species within the genus *Iris*, whereas George divided many into separate genera. But, I noted, both believed that plants were related in similar groupings and they only disagreed on taxonomic rank. Peter replied, "of course, rank is everything". While experts may disagree, one important aspect of this book is that it is the first, in many years, to address the whole family with the synthesis of information from one individual's viewpoint.

Peter's understanding of the family has continued to change. His earlier work *The Moraeas of Southern Africa* (1984) did not include the genera *Bernardiella*, *Galaxia*, *Gynandriris*, *Hexaglottis*, *Homeria*, and *Roggevedia* which he now includes in *Moraea*. There is much to be said for a consistent application of rank. Other genera submerged in related genera include: *Anapalina* into *Tritoniopsis*, *Anomalesia*, *Homoglossum*, and *Oenostachys* into *Gladiolus*, *Anomatheca* into *Freesia*, *Schizostylis* into *Hesperanthes*, *Antholyza* into *Babiana*, *Synnotia* into *Sparaxis*, *Chamelum*, *Ona*, and *Phaiophleps* into *Olsynium*, *Catia*, *Itysa*, and *Tamia* into *Calydorea*, *Kelissa*, *Onira*, and *Phalocallis* into *Cypella*, *Tucma* into *Ennealophus*, *Cardenanthus* into *Mastigostyla*, *Ainea*, *Cardiostigma*, *Colima*, *Fosteria*, *Rigidella*, and *Sessilanthera* into *Tigridia*, and *Belamcanda*, *Hermadactylus*, and *Pardanthopsis* into *Iris*. All totaled, 34 genera are submerged into the remaining 66 genera.

Like most people, gardeners often resent change. These changes have actually occurred over a period of years, but this is the first modern synthesis to call attention to how far the current taxonomic thinking has come. We also have to note that many are still unaware that the Family Iridaceae is no longer included in the order Liliales. It is now nested in the order Asparagales along with the Orchidaceae.

Name changes suggest a second look at plants we may know under the old names. For example the Blackberry Lily, *Belamcanda chinensis*, appears

to have a lily-like flower, radially symmetrical, with a central style at its center. *Iris* have three petaloid style arms. Now under its new name *Iris domestica* we may now notice that the central column which at first appears as a single column is actually three petaloid style arms closely pressed together to appear as one.

Some years ago I had the pleasure of climbing a mountain outside of Rome with Peter and a half dozen other botanists. We were in search of *Iris sabina*, an endemic to the top of the mountain. We hiked for hours and saw thousands of plants but none were in bloom. Most of us took a break at the mountain peak, but Peter continued searching until he finally found plants in full bloom. I relate the story for two reasons. First, it illustrates that Peter is a botanist who has done an extensive literature review and of equal importance, is informed by first hand field experience. Second, it exemplifies his dogged determination to thoroughly complete a task.

I can think of no one who could have tackled the review of the family with greater authority and as completely. Sadly, with over 2,000 species, it is impractical for the scope of the work to include some description of each. But there are 233 color photos which provide some compensation.

Every student of the *Iris* family should have a copy of this book. In addition to its importance for researchers, taxonomists and hybridizers, The *Iris* Family provides valuable information that gardeners can translate to cultural practices. This landmark work is also a foundation for future study on *Iris*. I highly recommend it to our readers.

Robert R. Pries
107 Brothers Drive
Roxboro, NC 27574
E-mail: robertpries@embarqmail.com

CONVERSATION POLICY STATEMENT

The following policy statement was developed by an international consortium which included the representatives of the International Bulb Society, Alpine Garden Society (UK), North American Rock Garden Society, Chicago Botanic Garden and American Daffodil Society.

The total populations and diversity of many plant species across the world are in decline. Habitats are faced with increasing threats of destruction as mankind continues to develop the environment for urban, agricultural and recreational uses.

Plant societies are dedicated to understanding, preserving, growing, selecting, propagating and appreciating the natural flora of the earth. As plant enthusiasts, we share a responsibility to embody the principles of conservation in such a way that our activities as gardeners, horticulturists and botanists are in harmony with the wider concerns of preserving the environment.

Collection of plant material from the wild has left some species of plants facing extinction. The memberships of the undersigned organizations have agreed to abide by the following Code of Best Practice:

- We strive to support organizations that seek to preserve valuable wildlife habits as the sources for genetic variations and naturally thriving plants for generations to come.
- We do not support the practice of wholesale collection for resale of wild plants from their natural habitats. We condemn the practice of misleading the public by calling such collected plants nursery grown or nursery propagated.
- We support the practice of collection of seeds, cuttings, divisions, and the occasional selected individual from large populations of wild plants by knowledgeable and responsible individuals for the purposes of growing, studying, selecting, hybridizing and ultimately propagating and distributing such material to others.

Our support is tendered only where the value of such collection lies in scientific research, preparing herbarium records or propagating such material for horticultural or conservation purposes, and is further based upon the provisos that:

- Discretion is exercised in collecting seed, such that only part of the seed productions is taken.
- Living material is collected only in small amounts.

CONSERVATION POLICY STATEMENT

- In the case of rare plants, material is collected only upon a very limited basis and only where there is sufficient local stock to successfully perpetuate that population.
- We encourage our members to familiarize themselves with and comply with national and local legislation or regulations regarding the conservation of habitats and the collection of plant material.
- We support the sentiments of the various international conventions, such as CITES and the Biodiversity Convention.
- We welcome like-minded organizations to agree to follow this Code of Best Practice.

Schedules: Each plant society or conservation organization is encouraged to list species or classes of plants whose dwindling populations are of imminent concern to them. In this way, all groups can be guided by the knowledge of the specialists and share their concerns.

Adopted by International Bulb Society, July, 2000

Adopted by American Daffodil Society, November, 2000

Adopted by North American Lily Society Board, January 2001

CONTRIBUTOR'S GUIDELINES FOR HERBERTIA

Herbertia is an international journal devoted to the botany and horticulture of geophytic plants. A special emphasis of the journal is the Amaryllidaceae and other petaloid families rich in bulbous, cormous or tuberous plants, but articles treating any aspects of geophytes are welcome. Articles may be formal (scientific), informal (practical, informative), field reports, historical accounts, addendum notes, and timely reports of Society activities. Contributors are asked to adhere to the following guidelines when submitting papers. Manuscripts departing grossly from this format will be returned to the author(s) for revision.

1. Scientific or technical articles (e.g., taxonomy, plant physiology) submitted for publication in **Herbertia** will often be sent to an appropriate reviewer for peer review. Any article may be scrutinized for accuracy by an appropriate reviewer. Final decision for "acceptance" or "acceptance with revision" of manuscripts resides with the Editor; authors of rejected articles may appeal the decision to the IBS Board of Directors.
2. Manuscripts **must** be typed or produced with legible ink jet or laser printers on 8 1/2 x 11 inch paper. Double spacing should be used throughout.
3. An electronic copy of the manuscript **must** accompany the written copies. This should be provided on a CD/DVD or sent to the Editor as an e-mail attachment. Microsoft Word for Windows versions 6, 7, 97, 2000 and XP are preferred.
4. Scientific papers may be prefaced with a short abstract if appropriate and so desired.
5. Descriptions of taxa should follow conventional form as to construction of descriptive paragraphs, specimen citation, and synonymy. Use the following examples as a guide or consult journals such as *Systematic Botany*, *Brittonia*, or *Annals of the Missouri Botanical Garden*:

Callipsyche aurantiaca Baker. Refug. Bot. 3:t. 167 (1869). Neotype: Ecuador, El Oro, Ayabamba, 200 m, Andre 4262 (K).

Eucrosia morleyana Rose. Addisonia 7:3-4, pl. 226 (1922). Type:

Ecuador, Chimborazo, Huigra, 4000 ft, Rose & Rose 22593 (holotype, US; isotypes, GH, NY, S).

Eucrosia eucrosioides var. *rauhiana* (Traub) Traub. Pl. Life 22:62 (1966).

Callipsyche eucrosioides var. *rauhiana* Traub. Pl. Life 13:61 (1957). Type: Ecuador, Azuay, Pasaje, 300 m, Rauh & Hirsch E15 (holotype, MO)

Bulb large, 7.7-10 cm long, 6-7.7 cm in diameter; tunics tan-brown; neck (2.5)-5-8 cm long, 2-2.6 cm thick. Leaves 2, hysteranthous; petiole 27-35 cm long, 7.5-10 mm thick, deeply channelled for most of its length; lamina ovate-elliptic, 29-40-(50) cm long, (12)-16-22 (29) cm wide, acute or short-acuminate, basally attenuate to the petiole, thick, coarsely undulate, hypostomatic, abaxial cuticle thickly striate and non-glaucous. Scape (5)-7-9(10) dm tall, ca. 10 mm in diameter proximally, ca. 4-6 mm in diameter distally; bracts 3-(5) cm long, lanceolate. Flowers (7)-10-12 (13), zygomorphic, all reaching anthesis concurrently, more or less perpendicular to the axis of the scape; pedicels (11)-22-33 mm long, 1-2 mm in diameter; perianth (2.8)-3-4-(4.4) cm long, green in bud, yellow at anthesis, rarely orange or pink, compressed laterally giving the perianth a somewhat flattened appearance; tube sub-cylindrical, 5-7 mm long, ca. 5-6 mm wide, constricted at the ovary to ca. 3.8 mm wide, concolorous with the tepals for most of its length, green only at the base; tepals spreading dorsally and ventrally to 23-29 mm wide, recurved and sometimes stained green apically; outer tepals (20)-23-29-(36) mm long, 5-6 mm wide, apiculate, lanceolate, keeled, 2 of them situated laterally, one dorsally; inner tepals 20-26-(34) mm long, obtuse, oblanceolate-spatulate, margins undulate at the middle, 2 of them ca. 9.5 mm wide and situated laterally above the 2 lateral outer tepals, the third one 5-7 mm wide, ventrally declinate and with the lower lateral tepals forming a pseudo-labellum. Stamens subequal, 8.5-11 cm long, filiform, long-declinate, ascendent in their distal 1/4, green; filaments dilated and connate in their proximal 2-3 mm; globose nectar glands present at the perianth throat, each 1-2 mm in diameter; anthers 5.5-6 mm long, oblong; pollen green, the exine mostly tectate-perforate. Style 10-11 cm long, green; stigma less than 1 mm wide. Ovary ellipsoid, 6.5-9 mm long, 4-4.5 mm wide; ovules 20 or more per locule. Capsule 2.5-3 cm long, 17-22 mm in diameter; pedicel 5-6 cm long; seeds numerous, blackish-brown, ca. 6.5 mm long, 1.5 cm wide. $2N = 46$. Flowering July-September and December-January.

Ecuador. El Oro: between Santa Rosa and La Chorita, 0-100 m, Hitchcock 21139 (GH, NY, US). Chimborazo: Río Chanchan canyon between Naranjapata and Olimpo, terrestrial in rock wall crevices, 800 m, (ex hort), Horich ISI # 214 (UC). Between Huigra and Naranjapata, 600-1200 m, Hitchcock 20638 (GH, NY, US). Cañar: valley of Río Cañar near Rosario, 960 m, Prieto CP-18 (NY, S). Azuay: Road from Jiron to Pasaje, near Uzhcurrumi, dry, steep, rocky hillside, 840 m, Plowman et al. 4600 (GH), Plowman 7634 (F), Plowman 12024 (F). Km 97 on road from Cuenca to Saraguro, dry thorn scrub, ca. 1100 m [incorrectly typed on specimen label as 2400 m], Madison et al. 7517 (SEL). - Inhabiting semi-desert and dry, rocky canyons and hills of the lower inter-Andean valleys (100)-300-900-(1100) m. Endemic.

6. Descriptions of new taxa **must** be accompanied by a short Latin diagnosis or description. Holotype or isotype specimens **must** be deposited in a herbarium listed in the current edition of *Index Herbariorum*. A diagnostic drawing and/or photo documentation sufficient to distinguish the new taxon **must** accompany the text.
7. Figures preferably should be cited in numerical order in the text as follows: Fig. 1, Fig. 2, etc.; tables as Table 1, Table 2, etc. Figure captions should be provided for all figures at the end of the manuscript. If high quality digital scans of figures can be sent, this is preferred. Scans must have a minimum resolution of 1000 DPI, regardless of size.
8. Literature citations should follow the Harvard system. Author and year of publication are cited in the text with placement of parentheses depending on sentence structure:
 - One author: Doe (1989) or (Doe, 1989).
 - Two authors: Doe and Stein (1990) or (Doe and Stein, 1990).
 - Three or more authors: Doe et al. (1978) or (Doe et al., 1978).
 If there are two or more references with identical authorship and year, use lowercase letters in alphabetical order as designation: Stein (1989a) or (Stein, 1989a).

Citations must be listed in alphabetical order at the end of the paper using hanging indentations. Only the first word in titles of journal articles and book chapters is capitalized. Journal titles should not be abbreviated.

Sample literature formats are as follows:

Journal Article:

Stebbins, G.L. 1984. Mosaic evolution, mosaic selection and angiosperm phylogeny. *Botanical Journal of the Linnean Society* 88: 149-164.

Book Chapter:

Hammen, T. van der. 1979. History of the flora, vegetation and climate in the Colombian Cordillera Oriental during the last five million years. Pp. 25-32 in H. Larsen & L. B. Holm-Nielsen (eds.). *Tropical Botany*. Academic Press, London.

Book:

Baker, J.G. 1888. *Handbook of the Amaryllideae*. George Bell and Sons, London.

9. Figures accompanying contributions may be good quality line drawings, 35 mm slides, or high quality black and white or color photographs (as images). Electronic format for figures is strongly encouraged, and these should be sent in uncompressed TIF format. Color or gray scale photos should be scanned at 1000 dpi; line drawings at 1200. If black and white or color prints are submitted, a charge may be assessed to convert them to electronic format.
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